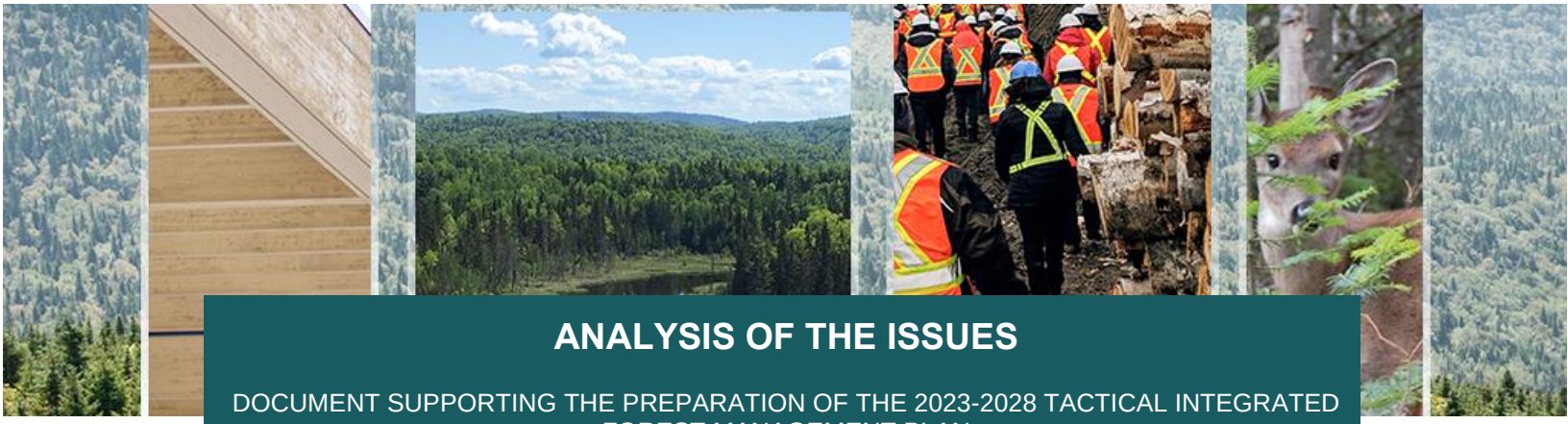


ANALYSIS OF THE ISSUES

DOCUMENT SUPPORTING THE PREPARATION OF THE 2023-2028 TACTICAL INTEGRATED FOREST MANAGEMENT PLAN

Nord-du-Québec Region

Table of Contents

Votre gouvernement

Québec

1. Ecological issues

Ecosystem-based management is an approach that seeks to preserve healthy and resilient ecosystems by focusing on reducing the gap between managed forest and natural forest. Since species are adapted to the historical fluctuations in forest attributes as shaped by the natural disturbance regime, keeping forests in a more natural state aims to preserve ecological processes and ensure the survival of most species. This concept is one of the means favoured under the *Sustainable Forest Development Act*. This is in line with Priority 1 of the second challenge in the Sustainable Forest Management Strategy (SFMS): **"Manage forests in a manner that preserves the main features of natural forests".**

To put ecosystem-based management into practice, an analysis of the main ecological issues raised by forest management activities is conducted for each Management Unit (MU). Determining forest management objectives and measures adapted to the local and regional realities will help reduce the gaps seen and be in line with the other objectives of the Tactical Integrated Forest Management Plan (PAFIT in French) in order to establish an all-encompassing management strategy.

The forest management conditions to ensure the maintenance or achievement of the objectives defined regarding ecological issues are deployed on three solution axes. These are exclusion of areas from harvesting, spatial and temporal distribution of interventions, and adapted silvicultural treatments. The way to materialize these solutions for each Management Unit is presented in the PAFIT, taking into account the synergies with other management objectives, the silvicultural potential and the local operational capacity. When applicable, a description of the principal means preferred will be provided per issue at the end of each section.

To learn more, consult:

Ecosystem-based management

1.1 AGE STRUCTURE

1.1.1 BACKGROUND

The forest age structure is defined as the relative proportion of stands in the various age groups, measured across a wide area (hundreds or thousands of km^2).

In natural forests, age structure is primarily determined by the disturbance patterns (fires, insect epidemics and windthrow) specific to each region. Forests where disturbances are common generally have a lower proportion of old-growth forests and more forests undergoing regeneration. In managed forests, logging operations are in addition to the natural disturbances. Optimizing forest yield, which tends to involve harvesting trees before their growth slows down, may contribute to fewer stands exceeding the age of maturity.

Old-growth forests are an important habitat for several specialized species, some of which may be sensitive to a high concentration of forests undergoing regeneration in the landscape. The increasing

rarity of old-growth forests and the overabundance of regenerating stands are therefore likely to influence biodiversity and ecological processes.

To learn more, consult:
Booklet 2.1 – Issues relating to forest age structure

1.1.2 LOCAL ANALYSIS OF THE ISSUES

The approach used assess the level of alteration of the age structure of managed forests versus average natural conditions.

1.1.2.1 Criteria

In order to identify issues related to the forest age structure, two development stages were targeted given their respective biological role: the stage of regeneration and the stage of old-growth stands.

Development Stage	Definition
Regeneration	The abundance of stands in the "regeneration" stage in a territory is an indicator of recently disturbed areas. This is generally associated with stands that are less than 4 m tall.
Old-Growth	A stand reaches the "old-growth" stage if it starts to acquire certain characteristics, such as a diversified internal structure, large-dimension trees (given the species and site) and dead wood in varying degrees of decomposition. It is taken for granted that these characteristics begin to be achieved from a certain time following a disturbance of natural or human origin.

The following table presents the criteria serving to distinguish the two development stages chosen based on the data contained in the current forest management. The criteria for the "regeneration" stage are based on the original date of disturbance (human or natural) and the criteria for the "old-growth" stage are based on age. The thresholds vary according to the dominant forest composition and forest growth in the different bioclimatic domains or the homogeneous vegetation units[1] (HVU).

Table 1: Age Thresholds Corresponding to the "Regeneration" and "Old-Growth" Development Stages

Bioclimatic domain	Regeneration	Old-growth
Spruce-moss stand	≤ 20 years old	≥ 101 years old

1.1.2.2 Characterization

Assessing the level of alteration makes it possible to make a qualitative diagnosis of the situation by classifying the difference versus the natural forest[2] and the risks of causing biodiversity losses[3]. The level of alteration may be low, moderate or high based on the proportion of residual habitats defining the thresholds. For the "regeneration" stage, the thresholds are based on the proportion of the area that they occupy, according to the bioclimatic domain and the HVU associated with the type of Spruce

[1] Homogeneous vegetation units are defined as "portions of territories with similar characteristics in terms of the relations of the vegetation (current and potential) and its explanatory variables".
[2] Forest composed of indigenous species, which has not undergone major transformation resulting from large-scale industrial use.
[3] This stage involves a certain degree of uncertainty, since knowledge of the minimum habitat characteristics needed to maintain the species is very limited.

stand. For the “old-growth” stage, the thresholds are established based on the intensity of changes versus the preindustrial profile[4].·

Table 2: Alteration Thresholds Used for Age Structure Management in Spruce-Moss Stands

Level of alteration	Area occupied per development stage (%)		
	Regeneration		Old-growth
	Maple and fir stands	Spruce-moss stand	
Low	< 20%	< 25%	> 50% of the reference rate
Moderate	≥ 20% to 30%	≥ 25% to 35%	≥ 30% to 50% of the reference rate
High	> 30%	> 35%	< 30% of the reference rate

The information presented in the original ecoforest map of the 4th decennial inventory program (2009-2012) and updated for the harvest and the disturbances to March 31, 2020 was used to produce the age structure evolution profiles. The regenerating forests were estimated on the basis of the time since the original disturbance of the stands and the old-growth forests, with age classes photo-interpreted by stand. For Spruce stands, the age classes dominated by 120-year, uneven-aged old-growth (VIN) and irregular old-growth (VIR) classes were chosen. For the state of the forest in 2020, which must account for aging since the 2009 mapping, the estimates show recruitment equivalent to 33% of the areas occupied by stands dominated by age class 90 after updating of the map.

1.1.2.3 Analysis Scale

The territorial analysis unit (TAU) was defined as being the "area in equilibrium” where the proportion of age classes stabilizes versus the size and frequency of total or severe natural disturbances. This scale provides a common base to compare the current age structure with the age structure of a natural forest.[5] To be consistent with the dynamics of natural disturbances, the dimension of the units varies based on the associated bioclimatic domain:

- < 500 km^2 for the Sugar Maple and Balsam Fir-Yellow Birch bioclimatic domains;
- < 1,000 km^2 for the Balsam Fir-Paper Birch bioclimatic domain;
- From 2,000 to 2,500 km^2 for the Spruce-moss bioclimatic domain.

1.1.3 CURRENT STATE

The tables 3, 4, 5 and 6 show the changes observed in forest age structure, especially the increasing rarity of old-growth forests and the overabundance of regenerating stands. The combined state of alteration of a TAU is determined according to the most restrictive development stage. The following maps illustrate the distribution of the combined levels of alteration of the region’s TAU.

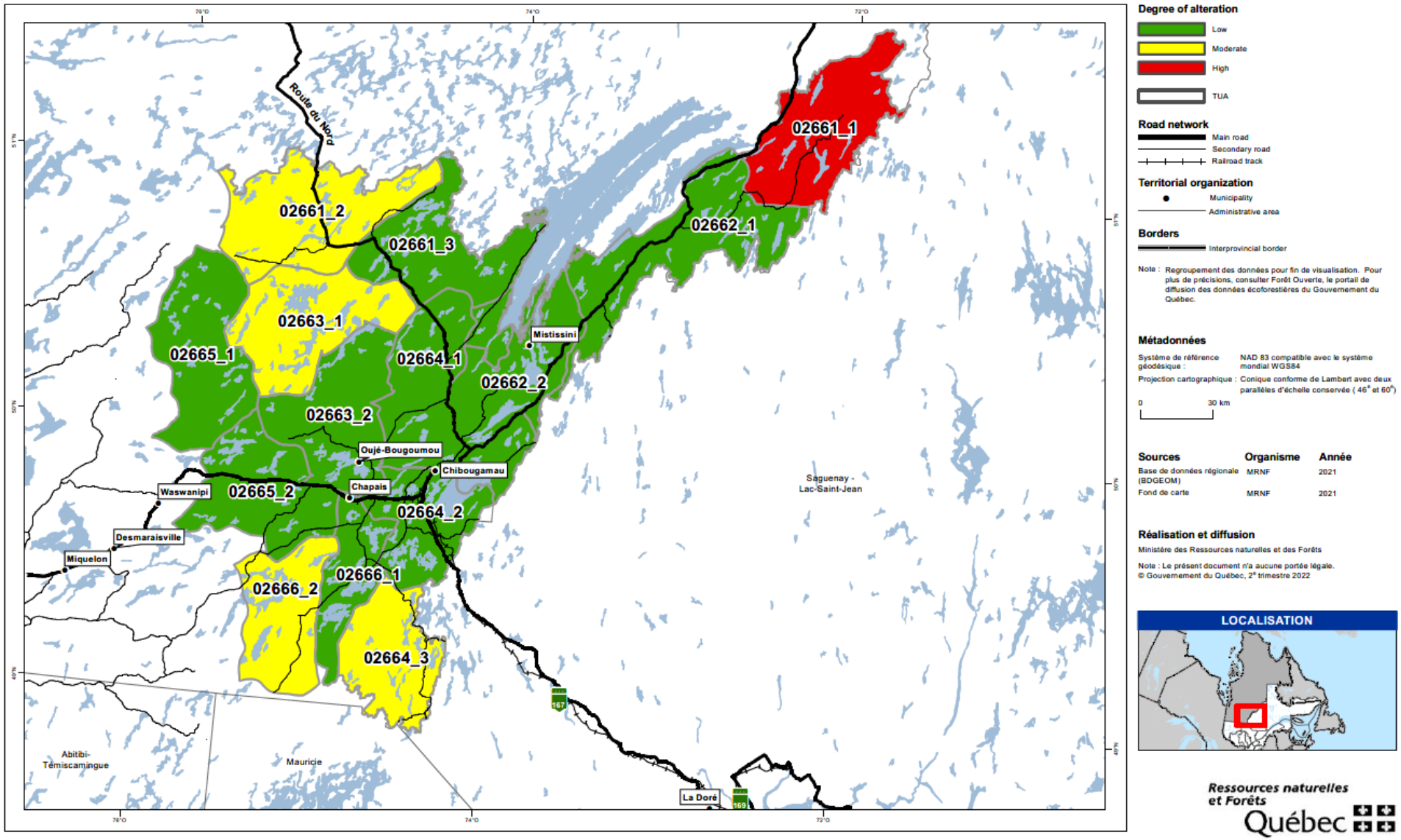
[4] A reconstruction of the age structure was carried out based on scientific studies in the French document *Le registre des états de référence* (Boucher et al., 2011).
[5] The productive forest areas excluded from harvesting (legally or administratively protected tenures, forest uses, operational constraints to harvesting) and located within the perimeter of the Management Units must be included in the baseline territory for this analysis.

Table 3: Level of Alteration of the "Regeneration" and "Old-Growth" Stages by TAU for the MUs Located in the East and Northeast of the Region

MU	Territorial analysis unit (TAU)	Homogeneous vegetation unit[1]	Area (ha)	"Regeneration" stage		"Old-growth" Stage			2020 combined level of alteration
				Rate (%)		Reference rate (%)	Rate (%)		
				2009-2012	2020		2009-2012	2020[2]	
02661	TAU 1	RCEt	207,147	42	43	69	45	45	High
	TAU 2	ROEt	199,660	24	18	49	10	15	Moderate
	TAU3	ROEt	151,867	36	16	49	26	28	Low
02662	TAU 1	RCEt	208,838	29	22	69	48	46	Low
	TAU 2	ROEt	75,334	17	8	49	29	27	Low
02663	TAU 1	ROEt	166,369	16	10	49	15	19	Moderate
	TAU 2	ROEt	145,125	6	9	49	22	31	Low
02664	TAU 1	ROEt	183,272	19	7	49	25	28	Low
	TAU 2	ROEt	108,676	13	11	49	37	35	Low
	TAU3	ROEt	139,492	29	28	49	20	24	Moderate
02665	TAU 1	ROEt	186,562	19	10	49	20	26	Low
	TAU 2	ROEt	157,078	10	14	49	24	27	Low
02666	TAU 1	ROEt	82,097	8	8	49	24	26	Low
	TAU 2	ROEt	134,319	28	15	49	29	24	Moderate

[1] Typical Western Black Spruce and Jack Pine forest (ROEt), Western softwood forest with Black Spruce and Southern Jack Pine (ROEm) and typical Central Black Spruce forest (RCEt).
[2] The estimated values in the old-growth stage accounts for recruitment of about 33% of the stands 80 to 100 years old to offset the aging of the forest map.

Map 1: Current Level of Alteration (2020) of the TAU Age Structure for the MUs Located in the East and Northeast of the Region



Map 2: Current Level of Alteration (2020) of the TAU Age Structure for the MUs Located in the South and West of the Region

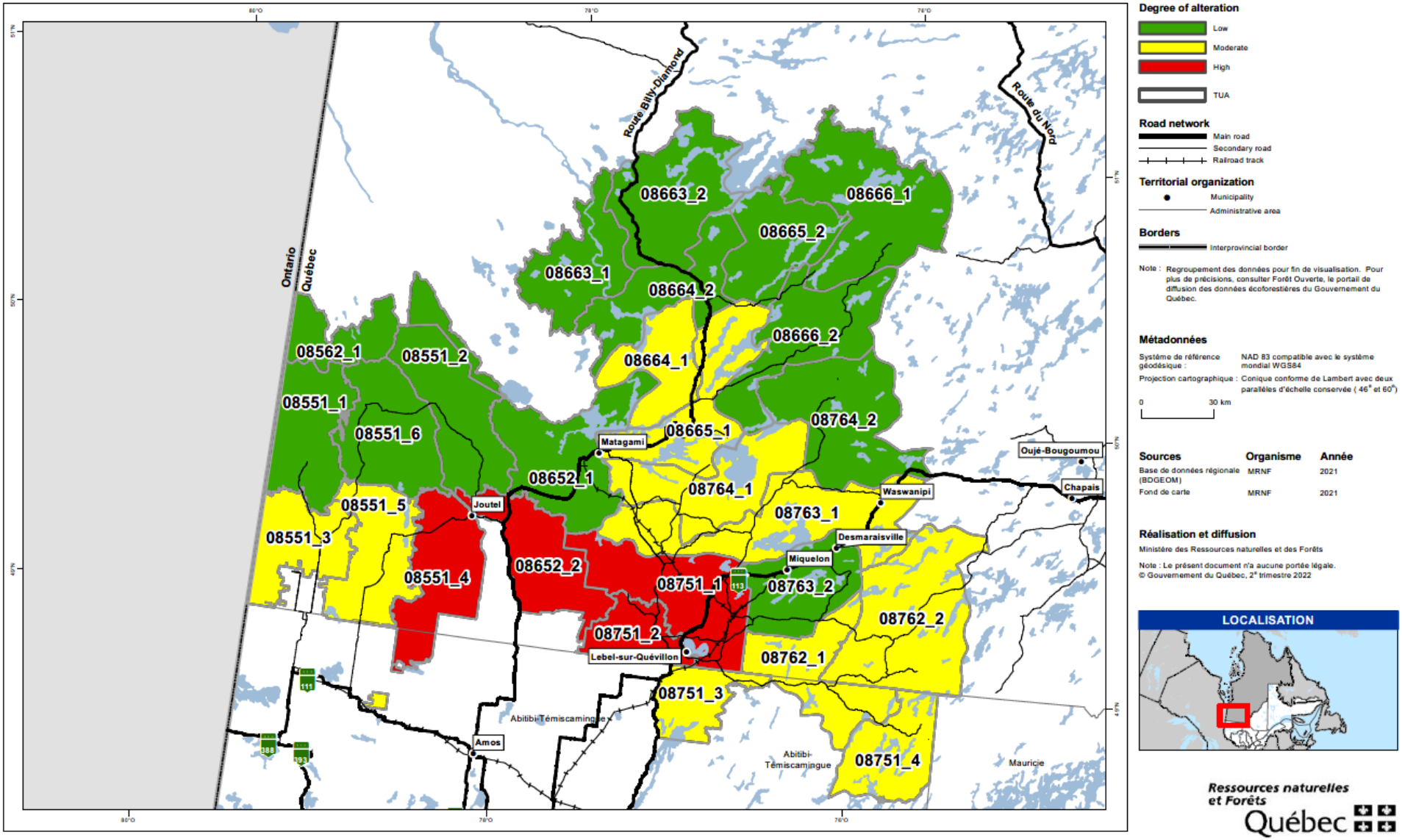


Table 4: Level of Alteration of the "Regeneration" and "Old-Growth" Stages by TAU for the MUs Located in the South and West of the Region

MU	Territorial analysis unit (TAU)	Homogeneous vegetation unit[1]	Area (ha)	"Regeneration" stage		"Old-growth" Stage			Combined state of alteration 2020
				Rate (%)		Reference rate (%)	Rate (%)		
				2009-2012	2020		2009-2012	2020[2]	
08551	TAU 1	ROEt	99,543	17	3	49	46	46	Low
	TAU 2	ROEt	86,825	20	9	49	35	40	Low
	TAU 3	ROEt	111,392	19	9	49	15	19	Moderate
	TAU 4	ROEt	149,403	16	6	49	8	11	High
	TAU 5	ROEt	131,711	26	14	49	15	20	Moderate
	TAU 6	ROEt	87,992	21	4	49	63	64	Low
08562	TAU 1	ROEt	65,627	16	5	49	43	47	Low
08652	TAU 1	ROEt	141,130	17	10	49	26	31	Low
	TAU 2	ROEt	129,688	26	21	49	4	11	High
08663	TAU 1	ROEt	84,850	15	10	49	65	68	Low
	TAU 2	ROEt	116,753	17	4	49	42	44	Low
08664	TAU 1	ROEt	72,997	1	8	49	17	23	Moderate
	TAU 2	ROEt	106,820	24	9	49	19	26	Low
08665	TAU 1	ROEt	137,801	15	14	49	10	15	Moderate
	TAU 2	ROEt	111,615	9	10	49	38	39	Low
08666	TAU 1	ROEt	196,840	17	15	49	35	38	Low
	TAU 2	ROEt	161,178	37	22	49	30	32	Low
08751	TAU 1	ROEt	179,487	21	12	49	9	14	High
	TAU 2	ROEm	73,978	5	6	49	4	5	High
	TAU 3	ROEm	72,070	20	22	49	16	22	Moderate
	TAU 4	ROEm	91,274	31	16	49	15	16	Moderate
08762	TAU 1	ROEt	128,400	39	14	49	19	22	Moderate
	TAU 2	ROEt	212,402	34	18	49	20	23	Moderate
08763	TAU 1	ROEt	200,814	14	9	49	15	17	Moderate
	TAU 2	ROEt	121,403	18	19	49	18	25	Low
08764	TAU 1	ROEt	143,718	17	11	49	15	18	Moderate
	TAU 2	ROEt	181,675	21	16	49	27	27	Low

[1] Typical Western Black Spruce and Jack Pine forest (ROEt), Western softwood forest with Black Spruce and Southern Jack Pine (ROEm) and typical Central Black Spruce forest (RCEt).
[2] The estimated values in the old-growth stage accounts for recruitment of about 33% of the stands 80 to 100 years old to offset the aging of the forest map.

1.1.4 OBJECTIVES

The objectives are to ensure that the age structure of managed forests is similar to what which exist in the natural forest. The provincial requirement states that **at least 80% of the area of the MU must present an acceptable difference with the natural forest (low or moderate level of alteration)**. Given the relatively small size of the MUs associated with the adapted forest regime, the choice was made to follow the indicator on MU groups when possible. The groups are based on the proximity of the MUs and the forest management regime applied. When the age structure state of the forests in a Management Unit or an MU group does not immediately allow the established threshold to be reached, a restoration plan must be done. This plan will initially consist of avoiding aggravating the situation in the short term by seeking to maintain the natural attributes and to achieve the objective over a realistic period of time.

Table 5: Tracking of Objectives for the Age Structure by MU or MU Group in the Region

Management Unit (MU) or MU group	Productive area (ha)	TAU area by level of alteration (ha)			Percentage of the MU with a below-average level of alteration (%) (Target ≥ 80%)
		Low	Medium	High	
02661 02662	842,846	436,039	199,660	207,147	75
02663 02665 02666	871,549	570,862	300,688	0	100
02664	431,440	291,948	139,492		100
08551 08562	732,493	339,987	243,103	149,403	80
08652	270,818	141,130		129,688	52
08663 08664 08665 08666	988,855	778,057	210,798	0	100
08751	416,809		163,344	253,465	39
08762 08763 08764	988,410	303,078	685,333	0	100

In light of these results, a high level of age structure alteration is recognized for MU and MU groups 02661-02662, 08652 and 08751. Nonetheless, considering a certain recruitment of old-growth forests since the original mapping, we estimate that the harvest and disturbance levels allow an increase in the level of old-growth forests in the landscape and control of the levels of regenerating stands. The control approach based on targets and deadlines and their integration into the allowable cut calculation allow control of this issue.

1.1.5 FOREST MANAGEMENT MEASURES

The forest management measures specify the preferred means to ensure the maintenance or achievement of this threshold. These are deployed based on three solutions, namely exclusion, spatial and temporal distribution of the interventions and the adapted silvicultural treatments. The way in which these solutions will materialize each forest management unit is presented in the PAFIT, taking into account the synergies with other forest management objectives, the silvicultural potential and the local operational capacity.

1.1.5.1 Exclusion

Portions of the territory where harvesting activities are prohibited (e.g. protected areas) or cannot be carried out because of different constraints (e.g. inaccessible sectors) will allow timely production of ecological processes and allow attributes of natural old-growth stands to develop and perpetuate over time.

Table 6: Potential for Exclusions in Maintenance and Recruitment of Old-Growth Forests

Management Unit	Abundance of Areas Excluded from Planning (%) in the Perimeter of the MUs[1]		
	Old-growth (≥ 100)	Short-term recruitment (≥ 80)	Long-term recruitment
02661	16	5	29
02662	10	2	5
02663	12	18	37
02664	4	4	5
02665	5	7	10
02666	1	0	1
08551	13	2	9
08562	41	14	40
08652	7	2	5
08663	47	7	31
08664	7	4	16
08665	7	1	5
08666	15	6	23
08751	2	2	8
08762	1	1	1
08763	3	2	9
08764	1	1	1
Region	**9**	**4**	**13**

[1] The areas considered here are the territories present in the Register of Protected Areas, the areas associated with caribou protection forest stands according to the plans in effect, and the interim measures of the territories subject to paludification, removed from planning to control the risks of non-sustainability of practices, and various territories where no forest harvest is planned. Other territories benefiting from piecemeal protective measures according to the legislation and regulations in effect could also contribute, but have not been considered here, because their contribution was considered more negligible.

1.1.5.2 Spatial and temporal distribution

Spatial Distribution for TAUs

The approach by territorial analysis unit makes it possible to discern the portions of the territory where the differences with the natural forest are the most significant, and for which efforts are needed to meet provincial requirements. Despite the achievement of the minimum requirements, maintaining TAUs at low levels of alteration within the Management Unit makes it possible to obtain conditions closer to natural conditions in places. This means covering a broader spectrum of biodiversity than would be possible by maintaining an average level over the entire territory, but also means modulating actions based on the forest context.

A level of alteration to be respected and a deadline to achieve it, accounting for natural evolution 1 (when more demanding than the current level of alteration) are attributed to each TAU. They will dictate that type and area of harvesting that may be done and the time when the objective must be achieved, particularly for MUs in restoration. As applicable, efforts must be made to maintain this proportion above the threshold corresponding to the defined level of alteration. The levels of alteration and deadline sought per TAU are presented in the PAFIT document of each MU.

1.1.5.3 Revolution or Rotation Lengthening

Compliance with the alteration thresholds makes it possible to ensure maintenance of old-growth forests, as well as the possible for creation of others over time. Thus, a proportion of the forests that will reach maturity will not be harvested so they can acquire the characteristic of old-growth forests. The approach increases the revolution[2] for these stands.

1.1.5.4 Adapted Silvicultural Treatments

Partial Cut

The use of partial cuts, such as shelterwood or selection cutting (CJ), allows maintenance of stands with old-growth forest attributes that continue to fulfil some of their ecological functions or allows acceleration of their deployment. Special attention must be paid when defining the harvesting methods in these stands to ensure that the key attributes associated with them are maintained (long-lived species,[3],large stems, dead wood, structure, etc.). These interventions allow to harvest part of the volume in the old-growth stands maintained in the TAU. However, it is recommended that they not be practiced on 50% of the old-growth stands of a TAU. The shelterwood levels applied per MU for the 2023-2028 period are presented in the PAFIT document.

[1] Evolution of the forest without forest management, calculated based on projections of the allowable cut calculation model by the Bureau du Forestier en chef. The data used to set the deadlines does not account for the risk of severe natural disturbances, such as forest fires or severe epidemics.
[2] Revolution: duration of the development cycle of a stand treated as regular high forest, from its origin to its loggable age (Glossaire forestier).
[3] Eastern White Pine, Red Pine, Spruces, Eastern Hemlock (Tamarack), Eastern White Cedar, Northern Red Oak and Yellow Birch are long-lived species.

1.2 SPATIAL ORGANIZATION

1.2.1 BACKGROUND

The spatial organization of the forest is the arrangement of forest stands in time and space.

In the natural forest, spatial organization results from the dynamics of disturbances (fires, insect epidemics and windthrow) typical of the territory. For the bioclimatic domains of the Balsam Fir stands, in the western portion, it is mainly fires from the hot and dry climate, while, in the east, the cool and humid climate leaves more room for insect epidemics. The Spruce bioclimatic domain is subject to forest fires. On the landscape scale, this gives rise to a matrix organized in mature forest stands, interspersed with openings of various sizes. They can be large randomly distributed areas or diffusely distributed aggregations in the forest cover. Regarding the disturbance scale, variations in intensity can create a mix of different levels of disturbance and undisturbed stands. Thus, following a serious fire, there is always a certain portion of residual standing forest.

Wildlife species adapt to conditions created by natural disturbances. For example, some species will benefit from young stands for their food, while others will prefer the contiguous forest cover. The way in which spatial attributes are organized in a managed forest can therefore have an effect on the maintenance of biodiversity and the functioning of ecological processes. Those to which particular attention must be paid concern the increasing rarity large forest tracts, the loss of connectivity and maintenance of interior forest conditions.

The Agreement Concerning a New Relationship Between Le Gouvernement du Québec and the Crees of Québec (ANRQC) favours a spatial organization that allows maintenance of the traditional way of life. Thus, the spatial organization is mainly based on block cutting. This distribution mode allows temporal and spatial deployment of harvesting. However, it is not favourable to maintenance of forest stands. To allow implementation of the ANRQC in the territory, it is necessary to derogate from sections 144, 145 and 146 of the *Regulation respecting the sustainable development of forests in the domain of the State* (RSDF), which define the aggregated cut block approach and require the maintenance of forest stands. Thus, the analysis for the spatial organization issue will be performed only for MU 08551, 08652 and 08751. For MU 02661, 02662, 02663, 02664, 02665, 02666, 08562, 08663, 08664, 08665, 08666, 08762, 08763, 08764, the derogation is presented in the appended PAFIT document.

To learn more, consult:

Booklet 3.1 – Issues relating to spatial organization of forests in Spruce-moss stands (in French only)
Booklet 3.2.1 – Spatial organization of forests in the bioclimatic domains of the fir forest — Orientations for tactical and operational planning (in French only)
Booklet 3.2.2 – Spatial organization of forests in the bioclimatic domains of the fir forest — Foundations of the approach *(in French only)*

1.2.2 LOCAL ANALYSIS OF ISSUES

The approach used apply a model for the distribution of forest interventions based on the natural forest and ensuring the availability of suitable habitats.

1.2.2.1 Criteria

Issues related to the forests spatial organization revolve around two important habitat attributes for the maintenance of species considered to be sensitive to development, namely the cover of a closed canopy forest and the interior forest.

Attribute	Definition
Closed canopy forest	The “closed canopy forest” or '”closed forest” is made up of stands of 7 m or more in height. This height offers a canopy that allows most species to move from a habitat to another.
Interior forest	The interior forest is the portion of the forest where the fauna and flora species live without being affected by environmental conditions (sunshine, wind, temperature, humidity, etc.) existing on the edge. The distance of the edge (edge effect) on the species dependent on the interior forest is approximately 75 m[1].

1.2.2.2 Analysis Scale

As ecosystem-based management is based on knowledge of the dynamics of natural disturbances, the spatial scale to be used for the analysis must be consistent with their effects both on the landscape and disturbance scales.

For the landscape scale, the territorial analysis unit (TAU) was defined as the "area in balance" where forest characteristics stabilize with respect to the size and frequency of natural disturbances. On the disturbance scale, the spatial organization compartment (SOC) is intended as a means of reproducing the size of the total or severe natural disturbances. The spatial scales of the TAU and SOC fit together to ensure complementarity for forest resource management. The dimensions associated with these spatial entities are presented in Table 7. They vary according to the type of natural disturbance specific to each bioclimatic domain.

Table 7: Spatial entity in Spruce stand

Spatial scale	Spatial entity	Size	Bioclimatic domain
Landscape	Territorial analysis unit (TAU)	Maximum of 2,500 km^2	Spruce stand
Disturbance	Spatial organization compartment (SOC)	Average of 30 to 150 km^2 [2]	Spruce Stand

[1] Stands that were harvested using partial cuts cannot be deemed to have an interior forest, but maintain the status of closed canopy forest. However, the effect of harvesting on the biophysical conditions of the forest diminishes as the canopy closes.
[2] Spatial organization compartments (SOC) are distributed in relatively equal proportions among the following three size classes: 30 to 70 km^2, 71 to 110 km^2 and 111 km^2 or more.

1.2.2.3 Characterization

When dividing the territory into SOC, it is important to consider the operational aspects of harvesting, such as synchronization of interventions, the main silvicultural regime and the access constraints. When the territory includes protected areas or bodies of water whose size is similar to that defined above, a specific SOC status is assigned to them. These preliminary analyses allow formation of SOC for the territory based on the following categories.

Table 8: Description of the Different SOC Categories

SOC category	Description
Standard	Spatial organization compartment in which clearcut areas are concentrated, with or without recent natural disturbance zones (fires, windthrow, insect epidemics). Standard SOC evolve based on the proportion of stands 7 m or higher contained within them.
Managed perennial forest stand	Compartment harvested in the form of partial cuts and clearcut areas of limited size (70 to 150 ha) so as to maintain forest stand characteristics (minimum of 70% stands 7 m or higher) in the long term.
Protected area	A compartment not subject to any development. In spruce stands, this compartment is considered to be a forest stand when it respects the characteristics specific to them, i.e., when it has an area of at least 30 km^2 in one block, and at least 70% of its productive forest area consists of stands 7 m or higher.
Lake	Mapping compartment that includes large bodies of water on the scale of a SOC (30 km^2 in Balsam Fir stands).

In the Management Units located in the Spruce stand, the approach based on forest stands and aggregated cut blocks is inspired by the dynamics of large-scale natural disturbances, such as fires. [1] The classic chronology of interventions in a standard SOC is a first passage when about environ 70% of the productive forest area is harvested to optimize 30% maintenance of residual forests. When the harvested areas have reached 7 m or greater, a second pass can take place. The residual forest left during the initial passage will be harvested without exceeding 30% so that the SOC can be eligible for forest stand status. In view of implementation of this cut distribution mode, three additional analyses are necessary on the scale of the Management Unit.

- The first analysis allows verification of whether the distribution of SOC with forest stand status (all categories combined) is ecologically adequate, considering a 10 m “zone of influence” outside these SOC. [2] This will make it possible to know the initial zone of influence of the forest stands within the Management Unit.
- Then, an analysis of the productive area occupied by the development stages is produced for each standard SOC to prepare synchronous harvesting in the first or second passage. A decision tree can determine those eligible for implementation of aggregated cut blocks (first passage) or residual forest harvesting (second passage) and those for which it is preferable to do nothing until the eligibility criteria are achieved (wait for a first or second passage).

[1] The purpose of this spatial organization is to concentrate the cuts spatially in aggregated cut blocks and then distribute them over time in the MU’s territory. In return, this allows maintenance of large closed-canopy forest stands with little fragmentation, well distributed on the scale of the MU.
[2] The territories located within this zone are considered to be close enough to forest stands to allow recolonization after cutting (Leboeuf, 2004).

- Finally, the SOC where the initiation or completion of a first passage is considered are analyzed based on the results obtained previously. SOC juxtaposed over more than 25% of their perimeter with a SOC dominated by regenerating stands [1] will allow identification of the risks of creating very large aggregated cut blocks.

Table 9: Age Criteria Corresponding to the Development Stages Used for the Spruce-moss Bioclimatic Domain

Development stage	Age criteria[2]
Regeneration	≤ 20 years old, depending on the year of the original disturbance
Premature	50-year, 70-year and uneven-aged young (JIN) age classes
Mature or Old-growth	90-year, 120-year and uneven-aged old-growth age classes (VIN)

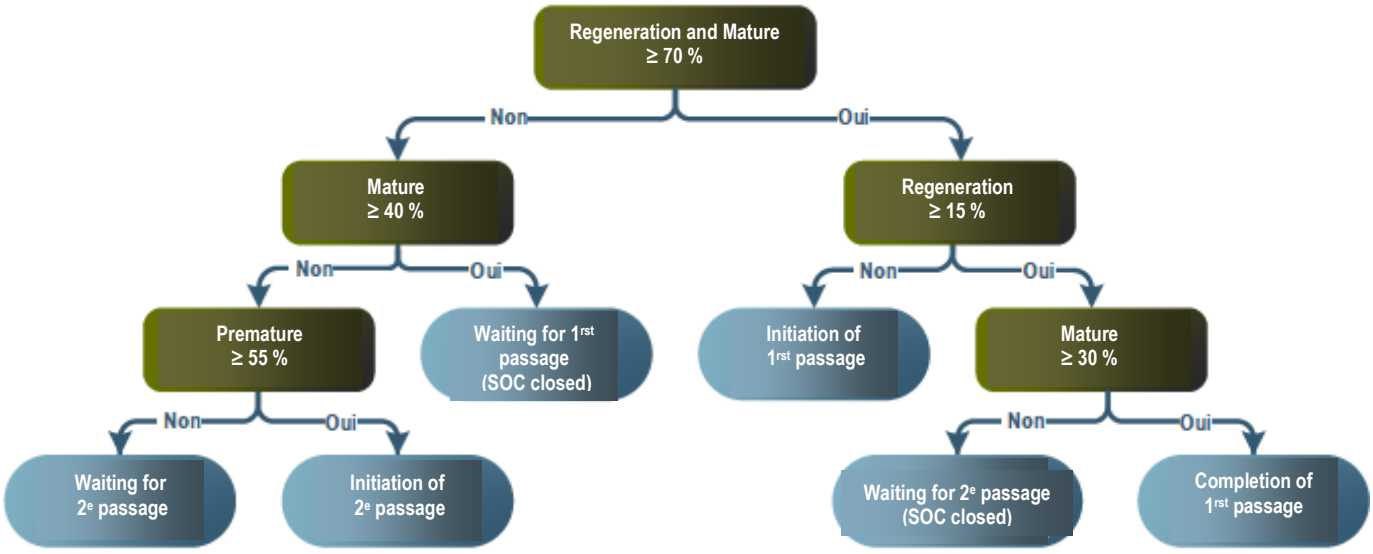


Figure 1: Decision Tree Allowing Determination of the Harvest Type Envisionable in Each Standard SOC Depending on the Relative Abundance of the Development Stages of the Stands

Regarding disturbances, the maintenance of residual forests comprising interior forest conditions must be ensured to meet the needs of the species associated with them. The Ministère des Ressouces naturelles et des Forêts (MRNF) has selected two forms conducive to maintaining habitats or functional connectivity with the surrounding forest matrix. Analyses will be done to ensure that these forms of residual forest exist in sufficient quantities, and that they are distributed in such a way as to play their ecological role.

[1] Productive forest area that contains more than 50% regenerating stands.
[2] Changes may be made to the age criteria according to the knowledge of local growth dynamics for a better representation of the regional realities.

Table 10: Characteristics of Residual Forest Forms to Follow in a Standard SOC for Spruce Stands

Residual forest form	Bioclimatic domain	Width	Size[1]	Inclusion[2]
Parcel	Spruce stand	200 m	10 ha	-
Block	Spruce stand	250 m	50 ha	≤ 25%

1.2.3 CURRENT STATE

The following figures provide an initial observation of the state of the territory based on SOC typology, including the location and abundance of the large forest stands.

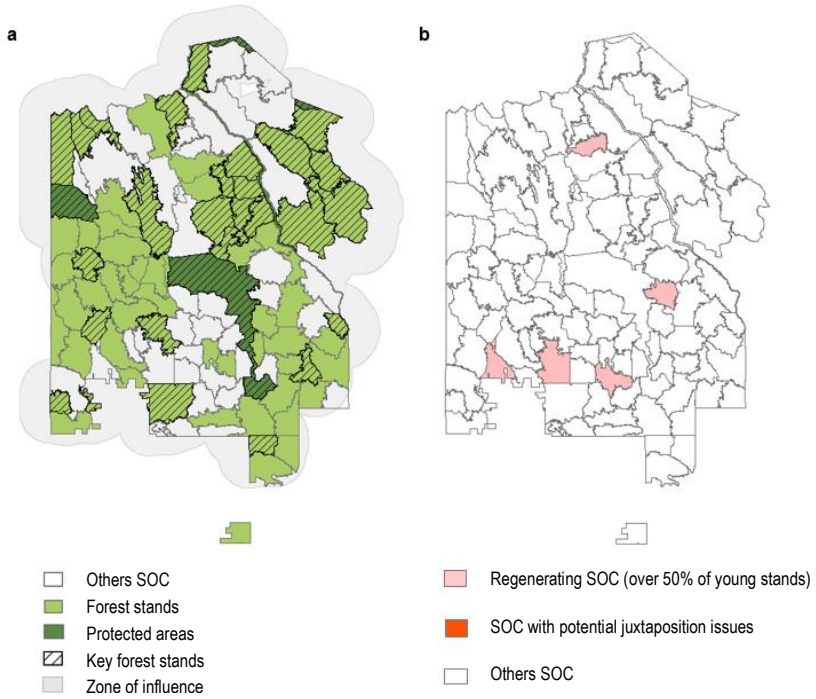


Figure 2: Management Unit 08551: a) 10 km zone of influence according to the current distribution of key forest stands and b) location of regenerating SOC and juxtaposition potential, if applicable

[1] In Spruce stands: the residual forest blocks and interior forest patches may not be crossed by any road and no cutting may be done.
[2] Maximum percentage of the area of the block that can be occupied by the forest less than 7 m high or inaccessible unproductive zones.

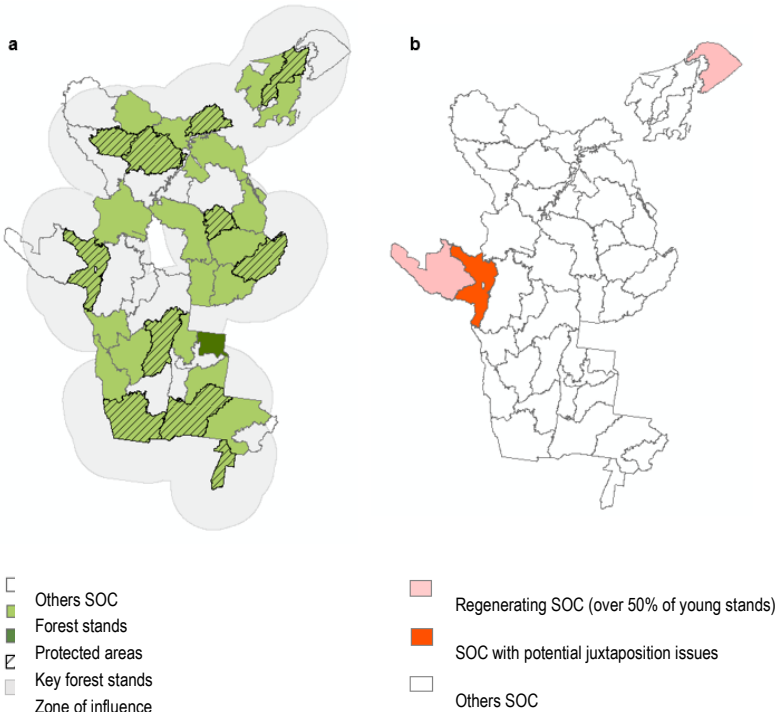


Figure 3: Management Unit 08652: a) 10 km zone of influence according to the current distribution of key forest stands and b) location of regenerating SOC and juxtaposition potential, if applicable

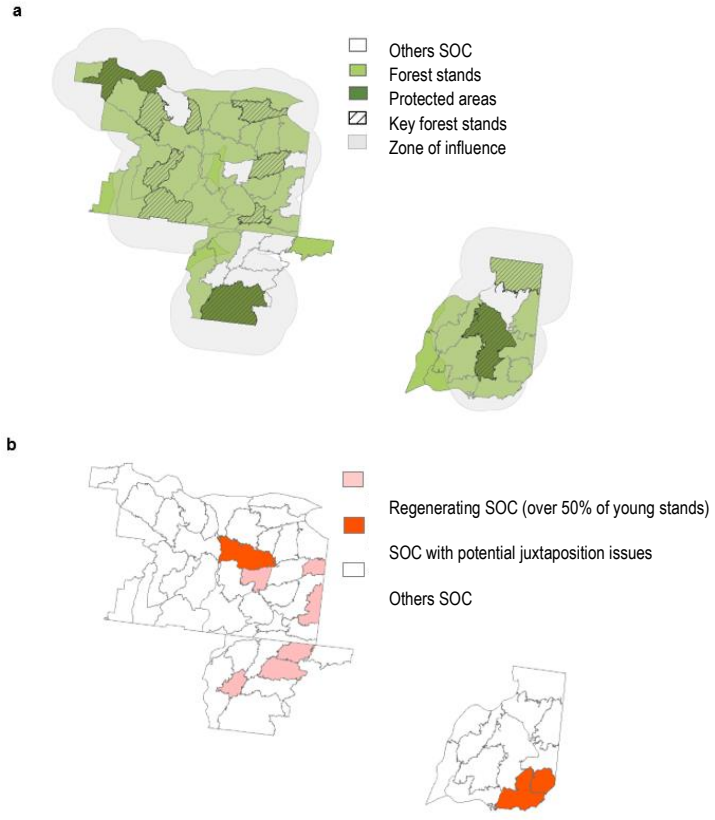


Figure 4: Management Unit 08751: a) 10 km zone of influence according to the current distribution of key forest stands and b) location of regenerating SOC and juxtaposition potential, if applicable

Given the scale of analysis, it is impossible to present the current configuration of the residual forest in the SOC. This will be assessed during operational planning.

1.2.4 OBJECTIVES

The objectives of the approach are to maintain or restore key attributes related to the spatial organization of natural forests on both the landscape and disturbance scales.

To carry out the deployment of interventions on a managed landscape, the MRNF has established tactical guidelines to be respected depending on the bioclimatic domain. The RSDF also provides for certain special provisions to be respected in Spruce stands.

Bioclimatic Domain	RSDF – Guidelines
Spruce Stand	At least 30% of the productive forest area of the SOC must be maintained as forest 7 m or higher.
Spruce Stand	A maximum of 10 years to complete a first or second passage of a standard SOC.
	A minimum of 20% of the total area of the MU must be occupied by forest stands.
	A minimum of 90% of the total area of the MU must be covered by a 10 km zone of influence around SOC with forest stand status.

The threshold of 30% of residual forest is based on the average proportion observed in landscapes affected by fire, and corresponds to the minimum proportion of habitats to be preserved, taking into account the risks of causing biodiversity loss. This threshold also helps ensure financial profitability during a second harvesting passage, In Spruce stands, each cutting passage must last less than 10 years to limit the effects of harvesting activities on wildlife and favour synchronization of development of forest stands.

Landscape-scale requirements commonly aim to ensure the connectivity of the forest matrix. However, these have been adapted to be more in line with the natural disturbance regime for each bioclimatic domain. In the Spruce domain, the requirements put more emphasis on the quantity and distribution of forest stands in the Management Unit so as to minimize the loss of connectivity between them. In addition, the concentration of cuts will favour reduction of the number of roads to be built and maintained, which will contribute to limiting excessive fragmentation of the territory.

Table 11: Tracking of Landscape Scale Objectives for Spatial Organization in Spruce Stands

MU	Area (ha)	Forest stand (%)	Key stand (%)	Zone of influence (%)
08551	1,039,705	66	32	98.7
08652	367,732	63	25	95.3
08751	535,512	86	24	92.6

On the disturbance scale, the MRNF has established operational guidelines to respect in order to regulate quantity, configuration, distribution and representativeness of the residual forest.[1]

Bioclimatic Domain	Guidelines
Spruce Stand	At least 20% of the productive forest area of a SOC must be organized into residual forest blocks 7 m or higher
	At least 80% of the baseline area[2] of a SOC must be found within 600 m of the limit of a patch or block of residual forest
	At least 98% of the baseline area[1] of a SOC must be found within 900 m of the limit of a patch or block of residual forest
	At least 20% of the proportion of each major type of cover (softwood, mixedwood and hardwood) must be represented in stands 7 m or higher of the SOC after harvesting.[3]
Spruce Stand	A strip of woodland at least 1 km wide composed at least 70% of stands 3 m or higher must be maintained for juxtaposition with the aggregated cut blocks.[4]

The interior forest is one of the key elements in the configuration of residual forests, so that they can offer sensitive species a forest environment conducive to their survival. Those organized in the form of blocks have several ecological, social and economic advantages, which is why a minimum threshold is defined. The distribution of residual forests within SOC is primarily aimed at maintaining the connectivity of residual habitats to promote the dispersion of biodiversity. As source habitat for recolonization of cutting areas, it is also important that the residual forest be composed of stands representative of those harvested (e.g. slope, density, stand type, station type, height class). This helps prevent forest stands that have less interesting characteristics for harvesting (e.g. species without buyers or inaccessible areas) from being overrepresented, especially since they are schedule for future harvesting.

1.2.5 EXCLUSION

The contribution of conservation forests (protected areas, biological refuges, etc.) to the spatial organization of forests must be taken into account at all planning scales. In the absence of serious disturbances, these portions of harvest-free territories are likely to maintain a high proportion of closed-canopy forests. Productive forest areas that are inaccessible (e.g. fragment) or benefit from special conditions can also be useful on the SOC scale. Depending on the area concerned, this contribution may be limited to that of a closed-canopy or interior forest if it meets the criteria.

[1] In certain cases, the history of the territory does not allow the operational thresholds to be reached even before intervening in the SOC. It will be not to aggravate the situation so that it can improve over time.
[2] The baseline area of a SOC is the area covered by a 900 m around the potential forest parcels of the SOC.
[3] If there are issues of composition or vulnerability to Spruce Budworm, the solutions developed to respond to these issues must be applied as a priority.
[4] Although it is permitted to juxtapose aggregated cut blocks with regenerating SOC by maintaining juxtaposition zones, this measure must only be used as a last resort. The purpose of this flexibility was to facilitate the transition from harvesting by block cutting and regeneration cutting with soil protection and regeneration (CMO-CPRS) to the ecosystem-based approach to spatial organization of forests.

1.2.5.1 Spatial and Temporal Distribution

Spatial Distribution on the MU Scale (Spruce Stand)

A zone of influence covering almost all of the Management Unit is perceived as an indication that the distribution of forest stands is relatively good. A set of “key” forest stands must be chosen that ensure coverage in compliance with the requirements. Several subsets of forest stands may exist that allow achievement of the same objective of maintaining the zone of influence. It is also important to consider that new forest stands will be formed in the landscape according to the growth of the stands. The location of the key forest stands thus may vary over time to adapt to this reality, except in the case of a managed perennial forest stand or a protected area. A harvesting priority then may be attributed to each SOC, based on the results obtained in the analyses. The selection of the key forest stands and the prioritization of harvesting must also be done by accounting for the forest context, particularly the constraints related to the age structure and vulnerability to SBW.

The distribution of the forest stands and the low harvesting priority granted to the SOC in a juxtaposition situation seek to avoid the concentration of large areas dominated by regenerating stands. When harvesting nonetheless must be done in the problem sectors, the application of mitigation measures, such as a juxtaposition zone, is required.[1] This will ensure a certain connectivity between the large closed-canopy forest stands within the forest matrix and mitigate the adverse effects of such a situation on the populations of organisms associated with the closed-canopy stands.

Spatial Distribution on the MU Scale (Spruce and Balsam Fir Stand)

The closer the proportion of residual forest in a SOC approaches the minimum threshold of 30%, the more biodiversity associated with the interior forest will depend on residual forests being in line with configuration and distribution (Figure 5). Nonetheless, this intra-SOC planning can be carried out with some flexibility in order to meet other objectives, such as the visual quality of landscapes or the maintenance of key habitats. A sound distribution of the blocks can mitigate the visual impacts resulting from the cut. For example, it is possible to make the shape of the residual forest more natural by not creating straight lines, geometric shapes and breaks in the ridge lines and by adapting them to the outline of the stands and the topography of the land.

[1] If a juxtaposition zone is applied, it is subtracted from the SOC, and the polygon thus created becomes the baseline for application of the guidelines.

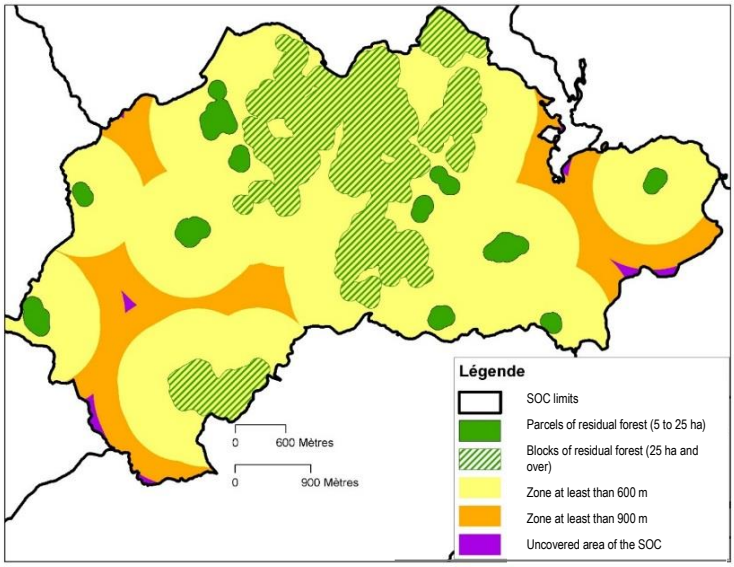


Figure 5: Example of Distribution of Residual Forest Patches and Blocks Using the 600 m and 900 m Zones

1.3 VEGETATION COMPOSITION

1.3.1 BACKGROUND

Vegetation composition refers to the diversity and relative proportion of tree species and certain other plants on both the stand and landscape scales.

In the natural forest, the composition of the forests is shaped by the interaction of different factors, such as the soil type, the climate and the disturbance regime (forest fires, insect epidemics, windthrow) specific to each territory. For example, following a total or severe disturbance, shade-intolerant species are usually the first to be established, and then are gradually replaced by shade-tolerant species (natural succession). Certain natural disturbances, such as insect outbreaks or disease, can reduce the variety of specific tree species in the canopy. In managed forests, logging operations are added to natural disturbances, which, in return, are attempted to be managed. This substitution has contributed to limiting the creation of conditions conducive to the establishment and survival of species favoured by the passage of fire. If no canopy or regeneration management is carried out following logging operations, the proportion of shade-intolerant species could increase compared with the natural state. Similarly, selective harvesting of certain species without regard to their regeneration can also lead to their increasing rarity; this was the case for Pines and Oaks from the mid-1800s.

Vegetation composition influences the availability of resources, such as light and substrates for flora, as well as the availability of food and habitats for fauna. The occurrence and severity of natural disturbances can also be influenced by vegetation composition. Increasing rarity or invasion of certain species in the forest is therefore likely to have impacts on the maintenance of biodiversity and ecological processes.

To learn more, consult:

Booklet 4.1 – Issues related to vegetation composition

1.3.2 LOCAL ANALYSIS OF ISSUES

The issue analysis approach will consist in evaluating the degree of alteration of the composition of the managed forests compared with the average natural conditions.

1.3.2.1 Criteria

Changes in vegetation composition can occur for a particular species, a combination of species and even a type of forest canopy. In order to assess the composition issues on the territory, different sources of information can be used.

On the ecoforest map, a species can be identified from the species group of the stands. Each species can have a code representing it individually or be included in a combination or association of species. The species for which issues of increasing rarity (↓) or invasion (↑) in Spruce stands are understood are presented in the following table.[1]

Table 12: Species of Concern in Spruce-Moss Stands

Group[2]	Species	Sugar Maple stand	Balsam Fir-Yellow Birch stand	Balsam Fir-White (Paper) Birch stand	Spruce-moss stand
R	Balsa\m Fir (Sb)	↑	↑	↑	↑
	White Spruce (Eb, Se)	↓	↓	↓	↓
FI	Paper Birch (Bp)	↑	↑	↑	↑
	Poplars (Pt, Pe)	↑	↑	↑	↑

A diagnosis can also be done with the ecoforest map regarding the relative proportion of cover types. This criterion will allow documentation of the hardwood or softwood invasion phenomenon of a given territory.

Table 13: Cover types

Cover type	Definition[3]
R (softwood)	**Softwoods constitute 75% or more of the basal area of the stand**
M (mixedwood)	Softwoods constitute 25% to 74% of the basal area of the stand
F (hardwood)	Softwoods constitute less than 25% of the basal area of the stand

[1] A summary of potential issues associated with plant composition and factors possibly involved in Quebec is presented in the appendix of Booklet 4.1
[2] Softwoods (R), shade-intolerant hardwoods (FI).
[3]Source: MFFP (2020), Cartographie du 5e inventaire écoforestier du Québec méridional — Méthodes et données associées [En ligne] [https://www.donneesquebec.ca/recherche/dataset/carte-ecoforestiere-avec-perturbations/resource/baf82702-bd8a-4754-8ebf-f903038ec1ab#:~:text=Cette%20cartographie%20couvre%20la%20quasi,1%20ha%20pour%20les%20perturbations.

Characterization

Assessing the level of alteration makes it possible to make a qualitative diagnosis of the situation by classifying the difference relative to the natural forest[1] and the risks of causing biodiversity losses.[2] This approach allows management of the uncertainty related to the limits of natural variability and the potential biases of the data sources. A high level of alteration can be assessed according to the intensity of the changes relative to the preindustrial profile.[3]

To manage the uncertainty related to the limits of natural variability and the potential biases of the data sources, a high risk of biodiversity losses was considered when the variance from the historical average exceeds 60% in the region. Based on the current knowledge, the risks of causing biodiversity loss are considered low when the variance from the historical average is less than 30% to 40%, but become critical variances over 70%.[4]

Table 14: Levels of Alteration Used for Vegetation Composition Management

Level of alteration	Area occupied by stands containing the species sought or for each cover type (%)
Low	± 60% of the reference rate
Moderate	< 60% of the reference rate
High	> 60% of the reference rate

1.3.2.3 Analysis Scale

The spatial scale to be used for this analysis must be ecologically consistent with the main factors influencing composition. A scale of higher levels, such as the homogeneous vegetation units, can be used to establish an overall diagnosis and will be easier to use as a common base for comparison with the historical description[5]. Subsequently, the use of a lower level, such as the station family, will allow a more precise diagnosis of the areas at risk or conducive to certain species

1.3.2.4 Station Family

A station family is a group of forest stations with similar silviculture, given the species to be promoted and the competing vegetation. [6] It is based on the potential vegetation that reflect the relationship between the current vegetation or vegetation likely to be established the characteristics of the environment where it grows and the impacts of the disturbances. Some stations are more susceptible than others to invasion by different species.

[1] Forest composed of indigenous species, which has not undergone major transformation resulting from large-scale industrial use.
[2] This stage involves a certain degree of uncertainty, since knowledge of the minimum habitat characteristics necessary to maintain the species is very limited.
[3] The composition of the natural forest can be obtained from aerial photos or aerial mapping, survey logs or previous inventories.
In the Management Units located in the Spruce-moss Forest, the information from the first decennial inventory (1970-1983) can serve as reference, because these territories still show a low level of forest management.
A reconstruction of the age structure was carried out based on scientific studies in the French document *Le registre des états de référence* (Boucher et al., 2011).
[4] For more information, consult Conservation de la biodiversité dans les paysages forestiers aménagés: utilisation des seuils critiques d'habitat (Rompré et al., 2010).
[5] The productive forest areas excluded from harvesting (legally or administratively protected tenures, forest uses, operational constraints to harvesting) and located within the perimeter of the Management Units must be included in the baseline territory for these analyses.
[6] Source: MFFP (2020), Cartographie du 5e inventaire écoforestier du Québec méridional — Méthodes et données associées [En ligne] [https://www.donneesquebec.ca/recherche/dataset/carte-ecoforestiere-avec-perturbations/resource/baf82702-bd8a-4754-8ebf-f903038ec1ab#:~:text=Cette%20cartographie%20couvre%20la%20quasi,1%20ha%20pour%20les%20perturbations.

Table 15: Potential Vegetation Associated with Each Station Family and Summary of Probable Species

Station Family[1]	Potential Vegetation[2]	Probable Species[3]
Softwood (Res)	RE1, RE2, RE3, RE4, RS3, RS4, MS2E, MS4	Black Spruce, Jack Pine, (Eastern Larch/Tamarack) [Epn, Pig, (Mel)] Balsam Fir, Black Spruce, Paper Birch, White Spruce, (Trembling Aspen) [Sab, Epn, Bop, Epb, (Pet)]
Softwood-intolerant hardwood [RFi] (Medium)	RS2	Balsam Fir, Black Spruce, Paper Birch, {Trembling Aspen, Jack Pine), Spruces [Sab, Epn, Bop, (Pet, Pig), Epx]
Softwood-intolerant hardwoods [RFi] (High)	MS2, ME1	Balsam Fir, Paper Birch, Trembling Aspen, Spruces [Sab, Bop, Pet, Epx], Black Spruce, Trembling Aspen [Epn, Pet']
Eastern White Cedar [Tho]	RS1, RC3	Eastern White Cedar, Balsam Fir, Paper Birch, Red Maple, Yellow Birch, Trembling Aspen, Spruces, Eastern Larch;/Tamarack-Eastern White Cedar, Balsam Fir, Black Spruce, Red Maple [Tho, Sab, Bop, Err, Boj, Pet, Epx, Pib, PruTho, Sab, Epn, Err]

CURRENT STATE

Table 16 allows recognition of the changes observed in forest composition regarding the frequency of a species in the cover.

Table 17 and Figure 6 present the proportion of the area occupied by each station family. This information makes it possible to estimate the each station family's contribution relative to the historical profile and understand the source of the downward or upward trend.

[1] The softwoods-intolerant hardwoods (RFi) station family has been subdivided to account for the severity of competition by intolerant hardwoods. The Eastern Hemlock (Pru) and Red Maple (Err) station families constitute advantages relative to Volume III of the Guide sylvicole du Québec for better capture of the issues associated with these species.

[2] To learn more about the potential vegetation, refer to the document Cartographie du 5e inventaire écoforestier du Québec méridional — Méthodes et données associées [Online] https://www.donneesquebec.ca/recherche/dataset/carte-ecoforestiere-avec-perturbations/resource/baf82702-bd8a-4754-8ebf-f903038ec1ab#:~:text=Cette%20cartographie%20couvre%20la%20quasi,1%20ha%20pour%20les%20perturbations.

[3] The parentheses mean that these species grow only at certain stations.

Table 16: Level of Alteration of Cover Types by MU and Their Evolution Since the 3rd Decennial Inventory Program

MU	Homogeneous unit[1]	Area (ha)	Estimated rate by cover type [2] (%)								
			F			M			R		
			Acceptable variance from the reference rate[3]	1992-1998	2009-2012	Acceptable variance from the reference rate	1992-1998	2009-2012	Acceptable variance from the reference rate[3]	1992-1998	2009-2012
02661	RCEt-ROEt	558,864	1 - 3	1	2	3 - 12	6	10	36 - 100	94	88
02662	RCEt-ROEt	281,750	1 - 2	1	2	2 - 10	9	12	37 - 100	90	86
02663	ROEt	311,115	1 - 3	1	2	4 - 14	11	10	36 - 100	88	88
02664	ROEt	432,806		2	2		14	14		85	84
02665	ROEt	343,049		1	2		12	10		87	88
02666	ROEt	216,071		2	2		15	17		83	81
08551	ROEt	666,197		7	7		18	16		76	77
08562	ROEt	65,758		1	1		8	9		91	90
08652	ROEt	270,143		8	11		30	22		62	67
08663	ROEt	201,450		1	1		2	3		98	96
08664	ROEt	179,296		3	4		10	11		87	85
08665	ROEt	249,063		6	6		18	14		76	80
08666	ROEt	358,325		1	2		9	9		90	89
08751	ROEM-ROEt	416,331	3 - 10	8	8	5 - 22	28	27	32 - 100	64	65
08762	ROEt	340,741	1 - 3	1	4	4 - 14	12	16	36 - 100	86	80
08763	ROEt	322,148		5	6		33	24		62	71
08764	ROEt	325,388		4	4		18	18		77	78

[1] Typical Eastern mixedwood forest with Balsam Fir and Yellow Birch (MEJt), Eastern mixedwood forest with Balsam Fir and Southern Yellow Birch (MESm).
[2] Remove the undefined cover area to calculate the current proportion.
[3] For MUs presenting more than one type of homogeneous vegetation unit, the reference rate was weighted according to the area occupied by each type.

Table 17: Breakdown of the Main Station Families1 Present by Management Unit

Management Unit	Station Family					
	Strong softwood-intolerant hardwood [RFi]		Softwood-intolerant hardwood [RFi]		Softwood (Res)	
	Area (ha)	Proportion (%)	Area (ha)	Proportion (%)	Area (ha)	Proportion (%)
02661	2,169.1	0	146,356.6	30	338,446.3	69
02662	5,809	1	99,396.9	38	155,756.3	60
02663	2,695	1	55,332.3	25	166,039.1	74
02664	14,032	3	120,810.7	30	264,209.1	66
02665	1,232	0	54,904.1	28	139,475.5	71
02666	4,557	1	67,788.8	38	106,223.3	59
08551	38,085	8	96,122.8	28	207,576.9	61
08562	778	0	3,220.5	17	14,958	79
08652	99,551	20	45,738.6	19	101,426.1	41
08663	2,725	1	13,214.3	9	135,261	89
08664	20,795	4	32,474.3	20	105,941	67
08665	12,999	3	57,126	46	55,119.2	44
08666	2,988	1	88,579.7	42	119,239.7	57
08751	60,107	12	165,039	48	119,240.2	35
08762	5,470	1	66,352.4	37	106,115.9	60
08763	21,259	4	113,091.2	50	89,742.4	40
08764	12,079	2	97,241.4	47	99,609.2	48

Most of the region's MUs are dominated by stations conducive to softwoods (Res), such as Spruce (Black or White) and Jack Pine. Five MUs (08652, 08665, 08751, 08763, 08764) show a significant proportion of stations more conducive to supporting mixedwood or predominantly intolerant hardwood stands (RFi or strong RFi). Although the presence of hardwoods may be naturally greater in these MUs, they could also present the most risk of hardwood invasion and loss of dominance of softwood cover. Figure 9 also illustrates this phenomenon where hardwood or mixedwood covers are essentially observed in the softwood-intolerant hardwood (RFi) stations.

[1] Softwood (Res), softwoods-intolerant hardwood (RFi).

Softwood (R), mixedwood (M), hardwood (F) cover, regenerating forest not yet showing identifiable cover (empty), stations conducive to softwoods (Res), mixedwood (RFi) or predominantly intolerant hardwood (RFi fort).

Figure 6: Distribution of Forest Cover Type by Station Family

1.3.4 OBJECTIVES

The objectives pursued with regard to vegetation composition of managed forests are to bring it closer to that of the natural forest. Given the time required for an action to have an impact on the species group scale, a short-term target may be difficult to achieve. Instead the intention will be to aim for a

gradual reduction of the variances from the natural forest to tend toward acceptable variances (low or medium level of alteration), considering the other forest management objectives. For increasing species, this will translate into the reduction and control of their abundance, while for decreasing species, they instead must be maintained and increased. The objectives determined based on the variance analysis may be modulated according to the regional diagnosis of vulnerability of the species to climate change.

In light of the results presented in the “Current State” section, special attention will have to be paid to the following factors, for each MU.

MU	Species or major cover type
02661 02662 02666	• Although on the whole, no major variance is observed, the proportion of hardwood and mixedwood covers seems to be increasing instead. An overabundance of mixedwood stands is also observed in MU 02662. • It is recommended to ensure management of the hardwood invasion by silvicultural tending in the young strata to ensure some representativeness of softwood species in the cover. • In accordance with the mixedwood stand management strategy arising from the adapted forest regime, management and recruitment of matured mixedwood stands must also be done.
02663 02664 02665	• No major variance from the historical reference rate is observed. Nonetheless, an increase in the proportion of hardwood cover is observed for MU 02663 and 02665, accompanied by a decrease in the proportion of mixedwood covers. • Temporary monitoring of the evolution of covers and maintenance of the level of tending is recommended. • In accordance with the mixedwood stand management strategy arising from the adapted forest regime, management and recruitment of mature mixedwood stands must also be done.
02666	• An overabundance of mixedwood stands is observed in this MU. In accordance with the mixedwood stand management strategy arising from the adapted forest regime, management and recruitment of mature mixedwood stands must be done, as well as management of young strata to control their representativeness in the long term.
08551	• This UA shows an overabundance of hardwood and mixedwood stands, but their proportion seems stable or decreasing. • It is recommended to continue the efforts to control the hardwood invasion in the young strata.
08562	• No cover issue is raised in this MU. • In accordance with the mixedwood stand management strategy arising from the adapted forest regime, management and recruitment of mature mixedwood stands must be done.
08652	• This MU still shows an overabundance of hardwood and mixedwood stands. The abundance of hardwood cover seems to be increasing, while mixedwood covers are decreasing. • It is recommended to continue the efforts to control the hardwood invasion in the young strata.
08663	• Although the proportion of mixedwood covers seems to be growing in this MU, it remains below the historical baseline. • Especially in this MU and in accordance with the mixedwood stand management strategy arising from the adapted forest regime, management and recruitment of mature mixedwood stands must be done.

MU	Species or major cover type
08664 08666	• No major variance is observed, but the proportion of hardwood covers nonetheless seems to be increasing. A slight overabundance of hardwood stands is also observed in MU 08664. • It is recommended to ensure management of the hardwood invasion by silvicultural tending in the young strata to ensure some representativeness of softwood species in the cover. • In accordance with the mixedwood stand management strategy arising from the adapted forest regime, management and recruitment of mature mixedwood stands must also be done.
08665	• Particularly in this MU and in accordance with the mixedwood stand management strategy arising from the adapted regiment, management and recruitment of mature mixedwood stands must be done • It is recommended to continue the efforts to control the hardwood invasion in the young strata. • In accordance with the mixedwood stand management strategy arising from the adapted forest regime, management and recruitment of mature mixedwood stands must also be done.
08751	• Instead, the proportions observed per cover in this MU have been stable since 1990. A greater proportion of mixedwood stands than the historical baseline is still observed.
08762	• This MU shows an overabundance of hardwood and mixedwood stands relative to the historical baselines, and the proportions observed seem to be growing. • Although in accordance with the mixedwood stand management strategy arising from the adapted forest regime, management and recruitment of matured mixedwood stands must be done in this MU. It is recommended nonetheless to pursue the hardwood invasion control efforts in the young strata with tending and land preparation treatments.
08763 08764	• Although issues of overabundance of hardwood and mixedwood covers are observed in these MUs, the level seems to be stable, and even decreasing. • It is recommended to pursue the hardwood invasion control efforts in the young strata and, in accordance with the mixedwood stand management strategy arising from the adapted forest regime, to do management and recruitment of mature mixedwood stands.
All	• Although the issue could not be documented here due the absence of appropriate data, it is recommended to pursue the White Spruce reforestation and maintenance efforts in the mixedwood strata or in softwood-mixedwood stands.

1.3.4.1 Exclusion

Conservation forests (protected areas, biological refuges, exceptional forest ecosystems [EFE], etc.), inaccessible sectors or sites benefiting from special conditions will naturally evolve toward late-succession species specific to the potential vegetation (climatic stability stage). The dynamics of the vegetation thus will have the effect of reducing the proportion of **intolerant hardwoods** in the absence of natural disturbance. The mortality of light-demanding species will also favour the introduction of attributes, such as gaps and large ligneous debris necessary for the establishment of several species, such as **Spruces** and **Eastern White Cedar**.

Finally, certain types of rare stands, difficult to regenerate, without buyers or presenting constraints to forest management (e.g. Cedar stands) may be excluded from the harvest.

1.3.4.2 Spatial and Temporal Distribution

Revolution or Rotation Lengthening

Spruces and **Eastern White Cedar** are long-lived species. Revolution or rotation lengthening may be profitable for sexual regeneration by the creation of natural gaps and the availability of dead wood offering adequate germination beds. This lengthening allows the development of seed bearers and allows more time for establishment of a cohort of seedlings of these species, which are generally slow to become established and grow.

1.3.4.3 Adapted Silvicultural Treatments

Silviculture makes it possible to act on the composition of the treated stands. The silvicultural strategy for the management of a species provides for the application of a sequence of treatments as defined by a silvicultural scenario. A single silvicultural action may fulfil more than one objective by promoting the regeneration of increasingly rare species, while countering the invasion by Balsam Fir or intolerant hardwoods.

Partial Cut

The use of partial cuts in stands whose basal area contains enough increasingly rare species makes it possible to make part of the timber accessible, while maintaining the contribution to the composition targets. Shade-tolerant and semi-shade tolerant species, species such as **Spruces** and **Eastern White Cedar**, will benefit from the gradual opening of the canopy to become established or grow. Special attention must be paid when defining harvesting methods to ensure the maintenance of well-distributed seed bearers. Harvest intensity and the opening pattern must also meet the requirements of the desired species at the expense of **intolerant hardwoods**. The priority removal of **Balsam Fir** will allow reduction of abundance, if applicable.

Variable Retention Cutting

In stands containing a low proportion of increasingly rare species, the use of variable retention cutting favours the prolonged action of seed bearers of these species on the cutover. The treatment will also result in subsequent recruitment of large ligneous debris and maintenance of quality germination bed. Because this treatment belongs to the clearcut family, it will take some time before the return of desired species can contribute to the composition targets.

Artificial Regeneration

The use of this silvicultural treatment category can be considered when deployment of the desired species regeneration is insufficient or when the station conditions are conducive for the survival and maintenance of the increasingly rare species that was harvested. Uniform planting consists of planting plants at regular intervals; it is mainly used following after clearcutting. However, fill planting aims to ensure full forestation of naturally regenerated areas (e.g. gaps, logging trails) and the desired species composition. These practices target softwood species, such as **White Spruce**, in monospecific or mixed cultivation.

Land Preparation

Adequate germination beds foster the seed germination of **Spruces** and Eastern White Cedar. Exposing the mineral soil or mixing the mineral and organic layers by means of scarification allows the creation of favourable microsites, in addition to temporarily eliminating herbaceous and shrub competition or competition resulting from **intolerant hardwoods** and pre-established **Balsam Fir**. This type of intervention is generally required before proceeding with reforestation, but can also be applied following partial or variable retention cutting to take advantage of natural seeding.

Tending Treatment

Once regeneration has been established, with the exception of beds that have been densely regenerated with the desired species and sites where competition is low, it is necessary to use tending treatments to ensure the maintenance of the target composition. This is particularly the case for species such as **Eastern White Cedar** and **Spruces**, which grow slowly compared to **intolerant hardwoods** or **Balsam Fir**.

The forest management levels applied per MU for the 2023-2028 period are presented in the PAFIT document. Tending treatments and shelterwood are the object of special follow-up (issue-solution sheet) on sites conducive to hardwood invasion, namely stations ME1, MS2 and RS2.

1.4 INTERNAL STRUCTURE

1.4.1 BACKGROUND

The internal structure of stands is defined as the spatial and temporal arrangement of the vegetation components, living and dead, of a stand.

In natural forests, the more time that has elapsed since the last major disturbance, the more likely a stand is to develop a complex structure (large trees, dead wood, gaps, vegetation understories, etc.). Then, when natural disturbances occur, variations in their intensity mean that a certain proportion of living trees may persist in the form of islands or scattered stems through the standing dead wood. These remnants that are inherited from a previous stand as a result of a disturbance are called "biological legacies", and result in a diverse structure in the future stand. Although a major disturbance is likely to recreate forests with a regular structure, the naturally occurring regeneration cohort also exhibits some degree of heterogeneity. In managed forests, since forest revolutions are shorter than natural disturbance cycles, stands have less time to redevelop a complex structure. During harvesting by partial cutting or clearcut, harvesting measures and efforts to avoid "wasting" timber can reduce the number of large trees and the recruitment of certain forms of dead wood. The overturning of snags as a safety measure and windrows formed during full-tree harvesting operations can also alter the spatial distribution of dead wood, and the role it will subsequently play. Following regeneration cuts, tending treatments are often used to manage stand composition or quality. The systematic application of these treatments on a large scale could have impacts on biodiversity.

The internal structure of stands influences the availability of feeding, breeding and shelter substrates for animal species. The same applies to substrates for the establishment and growth of plant species. Studies have shown that forests with high structural diversity also support a greater variety of species or functional groups. The simplification issues to which special attention must be paid mainly concern stands with a complex structure, the increasing rarity of certain forms of dead wood and the standardization of the second-growth forest.

To learn more, consult:
Booklet 5.1 – Issues relating to internal stand structure and dead wood

1.4.2 LOCAL ANALYSIS OF THE ISSUES

The approach of analysis of the issues will involve assessing the level of alteration of the managed landscapes in relation to the average natural conditions and the key structural attributes within stands treated at various development stages.

1.4.2.1 Criteria

In general, three main types of structure are distinguished in a stand: the regular structure, the irregular structure and the balanced structure.[1] They are established based on the distribution of the trees according to the vertical and horizontal planes and the distribution of age classes, considered simultaneously.

Table 18: Structure of a Stand types

Structure of a Stand	Definition[2]
Regular	Stand that usually has a single-tiered vertical structure in which the trees belong to the same age class and have similar dimensions. The regular structure is found in stands resulting from a major disturbance where the natural succession begins again.
Irregular	Stand that has a two-tiered or multi-tiered vertical structure in which the trees are usually distributed among two to four age classes, according to an unbalanced diametrical structure. Irregular structures are observed in stands subjected to partial disturbances of low to moderate severity.
Balanced (Inverted "J")	Stand with a multi-tiered vertical structure composed of trees belonging to at least three age classes, occupying an equivalent space on a limited surface. It may develop in stands composed of long-lived and shade-tolerant species mainly subjected to disturbances on the scale of the tree.

[1] For the purposes of the analysis, the irregularly structured and balanced stands will be grouped under the same heading.
[2] Source: MRN (2013), *Le guide sylvicole du Québec, tome 2. Les concepts et l'application de la sylviculture*, collective work under the supervision of C. Larouche, F. Guillemette, P. Raymond and J.-P. Saucier, Les Publications du Québec, 744 p.

Structure of Mature and Old-Growth Stands

Irregularly structured or balanced stands are the stands that present the most structure. Their abundance varies in the natural landscapes according to the disturbance regime. We will seek here to determine their abundance and that of their analogue (managed stands that present the characteristics sought).

Increasing Rarity of Certain Forms of Dead Wood and Structural Attributes in Managed Forests

Other aspects of the internal structure concern the retention of key attributes, such as:

- Snags and large-diameter trees;
- Hardwood trees in the mixedwood boreal forest;
- Coniferous trees in the hardwood forest;
- Ligneous debris on the ground and snags with varying degrees of composition;
- Small ligneous debris, such as branches and crowns.

These attributes, which develop naturally under a natural disturbance regime, are sometimes less abundant or non-existent in the managed forests. Short rotations and revolutions, which are meant to minimize losses by mortality, limit their development, particularly large snags and recruitment of dead wood on the ground. Regeneration cutting and salvage cutting after natural disturbances also greatly reduce the intake of dead wood in the first stages after the disturbance.

Simplification of Young Stands

Once regenerated, the second-growth forest has key attributes, such as a dense shrub stratum that can provide a lateral visual obstruction, a protective cover and an abundance of food (berries, hardwood stems, etc.) beneficial to certain wildlife species. This is particularly the case for regularly structured stands belonging to the 10 and 30-year age classes,[1] whether they are natural or the result of planting. We will seek here to evaluate the concentration of silvicultural work in these young stands.

1.4.2.2 Characterization

Complex Structure

Assessing the level of alteration makes it possible to do a qualitative diagnosis of the situation by classifying the variance from the natural forest[2] and the risks of causing biodiversity losses.[3] The proportion of irregular old-growth stands (> 201 years old) in the natural landscape can be obtained from the average recurrence interval of the different types of severe disturbances (fires, epidemics, windthrow). The level of alteration can be low, medium or high, according to the intensity of the changes relative to the preindustrial profile.[4]

[1] The analysis must include the productive areas corresponding to these age classes according to the year of the original disturbance.
[2] Forest composed of indigenous species, which has not undergone major transformation resulting from large-scale industrial logging.
[3] This stage involves a degree of uncertainty, since knowledge of the minimum habitat characteristics necessary to maintain the species is very limited.
[4] The age structure was constituted based on scientific studies in the French document *Le registre des états de référence* (Boucher et al., 2011).

Table 19: Alteration Thresholds Used for Vegetation Composition Management

Level of Alteration	Area occupied by irregular stands (%)
Low	> 50% of the reference rate
Moderate	≥ 30% to 50% of the reference rate
High	< 30% of the reference rate

To assess the presence of stands with a more complex structure in the landscape, it was considered that the forest mapping stands presenting a double age class containing 70, 90 or 120 years or VIN (uneven-aged old-growth) as a first age class and all the stands presenting a VIR (irregular old-growth) age class were the most likely to present the desired structural characteristic.

Presence of Legacies

As in the case of naturally disturbed forests, sometimes physical conditions (e.g. steep slopes, rough terrain, wet zones) or circumstantial conditions (e.g. volume without buyers, harvesting cost) cause portions of the cutover or trees to be left during forest operations. Added to this are the different forest uses and the sensitive sites excluded from forest management under legal, regulatory or administrative protections. A second analysis will accounts for these “operational” biological legacies by first assessing their ecological contribution. A classification of their abundance will make it possible to determine the portions of territories that are most likely to suffer from deficiencies.

Table 20: Classification Used for Management of “Operational” Biological Legacies

Abundance class	Proportion of the area, volume or basal area
Abundant legacies	Dead legacies and living legacies are frequent (> 10%), well distributed and representative of the composition.
Present legacies	Dead legacies are still present and there are living legacies (5% to 10%). Certain deficiencies of composition, location or configuration are present.
Absent legacies	Dead legacies (merchantable snags) are occasional or rare. There are very few living legacies (< 5%).

Because the Nord-du-Québec region presents few major altitude differences, with relatively homogeneous forests in composition and structure, it was considered that in the absence of specific planning of these forests, harvesting operations leave few biological legacies after harvesting. No profile will be presented here for this purpose. Nonetheless, the variable retention cutting level presented in the PAFIT accounts for this issue for all of the region’s MUs.

1.4.2.3 Simplification of Young Stands

The tending treatments locally alter stem density and the proportion of certain plant species. If, following these interventions, the habitat conditions are no longer conducive to their maintenance, the animal species will abandon the environment. In general the treated stands become interesting again for small wildlife five years after the intervention. The proportion of young strata that have been the subject of tending treatments[1] in the past five years was analyzed. This will make it possible to determine the portions of territories at risk of presenting deficiencies in the attributes sought.

1.4.2.4 Analysis Scale

As ecosystem-based management is based on knowledge of the dynamics of natural disturbances, the spatial scale to be used for the analysis must be consistent with their effects, both on the landscape and disturbance scales. On the landscape scale, the territorial analysis unit (TAU) was defined as the "area in equilibrium," where forest characteristics stabilize with respect to the size and frequency of total or severe natural disturbances. Although this scale allows the establishment of a common basis of comparison for the forest age structure, the imprecision regarding the abundance of irregularly-structured stands impelled us to use the Management Unit (MU) as a basis of comparison. To do this, the target was weighted in the MU according to the area occupied by each homogeneous vegetation unit in the landscape.[2]

On the disturbance scale, the spatial organization compartment (SOC) is intended as a means of reproducing the size of the original total or severe natural disturbances. An analysis on this scale allows estimating of the proportion of young stands (10 to 25 years old) treated (pre-commercial thinning, cleaning or clearing) over the past five years to balance the objectives of timber production and maintenance of wildlife habitats. Because no SOC are defined in the majority of the MUs of the Nord-du-Québec region, the assessment of the proportion of young stands treated was performed on theoretical territorial units, hexagons of 6,000 ha (60 km^2) uniformly distributed over the region's 17 MUs. It can also be used to assess the treatment rate of young stands to detect the places where high concentrations of tended stands are found.

1.4.3 CURRENT STATE

1.4.3.1 Structure of Mature and Old-Growth Stands

Table 21 and Figure 7 show the changes observed in the internal forest structure regarding the proportion of irregularly structured stands in the landscape.

[1] This analysis considers all types of cultivation processes combined (pre-commercial thinning, cleaning, clearing, etc.). Additional analyses can be carried out if necessary to go a little further in understanding the impacts of certain treatments.
[2] The productive forest areas excluded from harvesting (legally or administratively protected tenures, forest uses, operational constraints to harvesting) and located within the perimeter of the Management Units must be included in the baseline territory for these analyses.

Table 21: Level of Alteration of Irregularly-Structured Stands by MU During the Original Mapping of the 3rd and 4th Decennial Inventories

MU	Homogeneous unit	Area (ha)	Moderate alteration threshold according to the weighted reference rate	Rate 1992-1998[1] (%)	Current rate 2007-2012 (%)
02661	ROEt, RCEt	558,674	9 - 16%	6	6
02662	ROEt, RCEt	284,172	11 - 19%	16	8
02663	ROEt	311,494	7 - 12%	3	7
02664	ROEt	431,440	7 - 12%	4	7
02665	ROEt	343,640	7 - 12%	3	5
02666	ROEt	216,415	7 - 12%	5	9
08551	ROEt	666,866	7 - 12%	1	6
08562	ROEt	65,627	7 - 12%	1	9
08652	ROEt	270,818	7 - 12%	1	3
08663	ROEt	201,604	7 - 12%	1	6
08664	ROEt	179,817	7 - 12%	0	7
08665	ROEt	249,416	7 - 12%	2	6
08666	ROEt	358,018	7 - 12%	1	7
08751	ROEm, ROEt	416,809	7 - 12%	2	6
08762	ROEt	340,801	7 - 12%	3	8
08763	ROEt	322,217	7 - 12%	2	7
08764	ROEt	325,392	7 - 12%	2	7

1.4.3.2 Simplification of Young Stands

The situation concerning the complexity for young stands is presented in Table 20 and Figure 7. According to the 2019 data, 1,142 of 1,421 hexagons contained young stand habitat areas. Almost all of these, 1,416 hexagons, had a habitat treatment rate of less than 50% (green and yellow hexagons on the map). The five hexagons with a rate exceeding 50% are located in MU 08551, 08665 and 08751. The eleven hexagons with a treatment rate between 30% and 50% are located in MU 8551, 8664, 8665 and 8751.

[1] Because the photo-interpretation standards were specified between the 3rd and 4th decennial inventories, it is possible that the values presented for 1999-2002 are underestimated.

Table 22: Habitat Treatment Rate of Young Stands in 2019 for the Nord-du-Québec Region.

Treatment rate	Number of hexagons	Proportion of hexagons (%)	MU affected
0 to < 30%	1,126	98.6	All
30% to < 50%	11	1.0	8551, 8664, 8665, 8751
50% and over	5	0.4	8551, 8665, 8751

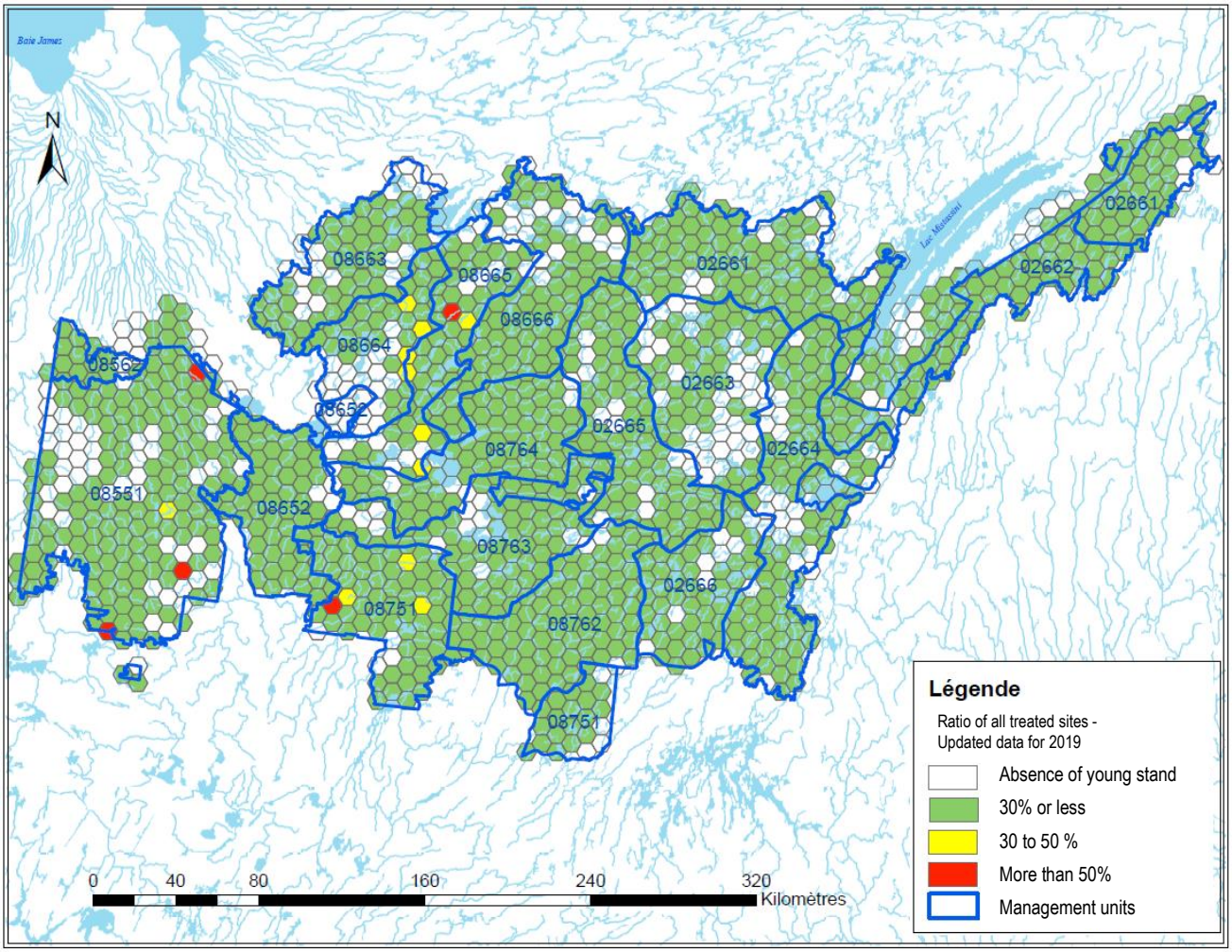


Figure 7: Habitat Treatment Rate in Young Stands in 2019.

1.4.4 OBJECTIVES

The objectives pursued regarding internal structure of managed forests are to ensure that it resembles that of the natural forest on the landscape scale and to ensure the maintenance of key structural complexity attributes on the cutover scale.

Given the time required for an action to have an impact on the cover succession, a short-term target may be difficult to achieve. Instead the intention will be to aim for a **gradual reduction of the variances from the natural forest to tend toward acceptable variances (low or medium level of alteration)**, considering the other forest management objectives. For the MUs that deviate considerably from natural conditions, it will be essential to avoid aggravating the situation in the short term by seeking to maintain the natural attributes still in place and then increase their proportion. The result obtained from the 4th decennial inventory corresponds to the result presented in the "Current State" section for each of the region's MUs.

In the Management Units where clearcuts occupy an important place in the silvicultural strategy, namely all of the region's MUs, **at least 40% of variable retention cuts that include retention measures of at least 5% of the merchantable volume will be planned.** The current literature points to the fact that 5% to 10% retention, on the stand scale, is a minimum proportion to be maintained so that the functional role of biological legacies is fulfilled (Gustafsson et al., 2012).

In order to prevent the risks of homogenization of stands resulting from clearcutting, it is necessary to avoid creating situations where recent tending treatments would be applied to more than 50% of young strata Otherwise, measures must be integrated into the silvicultural treatments to mitigate the potential impacts on wildlife. This will make it possible to preserve a proportion of the dense sapling stands, distribute the areas treated over the territory and maintain certain habitat attributes when an exceedance is justified.

1.4.4.1 Exclusion

The portions of the territory where harvesting activities are prohibited (e.g., protected areas) or cannot be carried out due to various constraints (e.g. inaccessible sectors) will naturally develop complexity attributes over time. Tree mortality from aging will allow a new cohort to develop in the gaps, resulting in diversification in the structure. If a natural disturbance occurs, there will also be legacies of dead and living wood in varying quantities and forms, since these territories are not subject to salvage cutting.

1.4.4.2 Spatial and Temporal Distribution

For a portion of the territory subject to forest management, the targets associated with maintenance of old-growth forests will allow rotation or revolution lengthening and thereby the development of a certain number of structural attributes (presence of gaps, snags, dead wood on the ground).

Since the tending treatments have the effect of reducing the wildlife habitat quality for over five years, a strategy of spreading the treatments over time can be considered, accounting for the silvicultural scenarios and the forest management objectives pursued. This distribution of interventions will make it possible to ensure the availability of suitable habitats and to avoid standardizing all the young stands in the short term.

1.4.4.3 Adapted Silvicultural Treatments

Partial Cut

Using partial cuts, such as irregular shelterwood (CPI) or selection cutting (CJ), makes it possible to create or maintain stands composed of at least two distinct cohorts of trees. Although this is already an attribute of complexity in itself, the effects of these treatments on the availability of large living or dead trees are poorly documented. Measures that target the retention of key attributes should be incorporated into silvicultural prescriptions and harvesting guidelines (with or without marking). In addition to maintenance of large-diameter trees, these measures could provide for retention in the form of:

- snags when they do not constitute a risk for workers;
- sparse stems or species clumps whose composition contrasts with the dominant cover.

Variable Retention Cutting

Retention of individual trees, clumps or islands allows improvement of the complexity of the harvested areas. To be considered as biological legacies, these must be maintained until the next revolution or rotation[1].

Type of Retention	Definition[2]
Individual Stems	Retention of individual stems meeting specific characteristics dispersed throughout the cutting area. This type of retention should not be chosen when the presence of sparse stems may hinder the performance of the next treatments of the silvicultural scenario (e.g. land preparation).
Clumps	Area of approximately 150 to 500 m² containing a minimum of five living merchantable stems and within which no intervention has been or will be performed. This type of retention should ideally be for areas of low vulnerability to windthrow.
Islands	Area of more than 500 m² within which no intervention has been or will be performed. Islands are particularly useful for the safe retention of snags or unstable trees, in addition to limiting the risk of windthrow.

In stands where clearcuts occupy a large proportion of the silvicultural strategy, the use of variable retention cutting makes it possible to offer a source of snags and ligneous debris for the future, complementing old-growth forests. The choice of retention methods will depend on the initial characteristics of the stands ready to be harvested, local forest management objectives and knowledge of the severe disturbances affecting the territory. To be considered as variable retention cutting, a minimum retention of 5% of the harvested volume (or treated area) must be planned in the form of biological legacies.

In order to play the role of seed bearers, nesting trees or perching trees, it will be desirable to:

- promote the maintenance of 20 cm mature and dying stems for stands dominated by Black Spruce or 40 cm for mixedwood or tolerant hardwood stands.

[1] Areas likely to be harvested in the near future (e.g., residual forest patches and blocks) cannot be associated with the notion of biological legacies since they are expected to play a temporary role.
[2] Source: MFFP (2020), *Catalogue des traitements de rétention variable*, 19 p. (internal document).

- promote the persistence of legacies by seeking to reduce the vulnerability of stands to defoliating insects and the windthrow risks;
- ensure an adequate distribution over the cutting area to avoid that large portions are not exposed to the influence of biological legacies (e.g. 25 to 50 stems/ha, number of clumps/ha).

Although it belongs to the clearcut family, cutting with protection of small merchantable trees (CPPTM) is a regeneration process that generates an irregular structure. It involves harvesting trees whose DBH is above a threshold of 13, 15 or 17 cm, and protecting as many softwood trees as possible whose DBH is below this limit. From this perspective, it may be advantageous, when a stand is eligible, to take advantage of it to achieve the objective of irregular stands.

Tending Treatment

Silvicultural treatments such as thinning out or clearing-cleaning potentially would have fewer effects than pre-commercial thinning on standardization of second-growth forest, given the absence of formal concerns about spacing between the residual stems. Since 2013, the tightening of the conditions of application of systematic pre-commercial thinning (EPC) have led to a gradual reduction of this treatment to the benefit of other tending practices, where only that stems competing with the crop trees are cleared or thinned. When required, special instructions may also be integrated into the silvicultural prescriptions to see to the retention of fruit trees or the conservation of islands of untreated productive areas distributed over the entire forestry sector. These means may apply to the naturally regenerated stands or to the plantations to the extent this does not compromise the investment.

1.5 RIPARIAN ENVIRONMENTS

1.5.1 BACKGROUND

A riparian environment is a transition zone between terrestrial and aquatic ecosystems, which generally includes a treeless zone, a moist riparian forest and a dry riparian forest. It extends over variable distances depending on the characteristics of the site, such as the topography and the nature of the soil.

Riparian environments generally are home to diverse vegetation and perform several hydrological and ecological functions that are essential to preserving the quality of aquatic habitats (sediment retention, reduction of shoreline erosion, heat shield, etc.). The proximity of water and the abundance of food also make riparian environments an attractive area for many wildlife species. This environment represents an essential or sought-after habitat for more than 50% of Quebec vertebrate fauna, and some species depend on it to complete one or more stages of their life cycle.

The Québec regulations ensure basic protection against forest management practices likely to compromise the integrity of riparian and aquatic environments, such as forest drainage, road construction, maintenance and machinery traffic. Add to this the protection afforded by a 20 m strip of woodland bordering a bog with a pond, a marsh, a swamp, a lake or a permanently flowing watercourse where only partial cutting is permitted. Studies show that the maintenance of these riparian strips, with a uniform width and without disturbing the soil, adequately ensures the protection of the physicochemical conditions of the water. In addition, the protection of riparian environments is enhanced by the conservation of certain sensitive wildlife habitats (waterfowl concentration areas, heronry, muskrat habitat, mudflats, salmon rivers, spawning areas, riparian environments located in a White-tailed deer yard). These measures may prove to be insufficient for certain specific ecological functions associated with large riparian environments (e.g. habitats of certain wildlife species, contribution of ligneous debris, etc.).

To learn more, consult:
Booklet 6.1 - Issues related to riparian environments

1.5.2 OBJECTIVES

The objectives pursued regarding riparian environments involve ensuring the preservation of rare types of natural communities and a representative share of riparian diversity. On the Management Unit scale, it is recommended to aim for a **15% minimum threshold of complete protection (excluding unproductive lands)** and an overall threshold of **30% of the territory subjected to special measures (complete protection and partial cutting) in all riparian environments**. These thresholds will contribute to conserving the proportion of habitats above the limit that that present a risk for maintenance of biodiversity. In addition, they ensure maintenance of riparian environments without harvesting to satisfy the most sensitive species.

1.5.2.1 Exclusion

Certain parts of the riparian environment involve constraints to forest management, particularly inaccessible sectors, forest uses, allotments or management modes that are excluded or in the process of exclusion from forest management. The riparian forest excluded from harvesting may over time develop structural complexity attributes (irregular structure, dead wood, large stems, etc.) prized by certain species associated with these environments.

In addition to large protected areas and areas excluded from harvesting, the region no longer plans partial cutting of 20 m riparian strips of woodland since April 1, 2013. The strips thus remain intact, as do the structural attributes that characterize them.

1.5.2.2 Spatial and Temporal Distribution

Spatial Distribution on the MU Scale

In addition to complete protection of the 20 m riparian strip, the region also presents several wildlife sites of interest (WSI) that support protection of riparian environments. To protect these sites, additional widenings are planned. These widenings may be subject to partial harvesting without passage of machinery. In some cases, WSI protection also provides for certain restrictions on the establishment of permanent infrastructure (roads, mining installations, gravel pits) nearby. These measures ensure increased protection at spawning sites or in more sensitive lakes on the MU scale.

Spatial Distribution on the SOC Scale

The positioning of residual forest blocks[1] along riparian environments allows a localized widening of the strip of woodland over a minimum of 200 m, until the adjacent cover reaches a height of 7 m. This protection offered at the time of operational planning has the purpose of maintaining closed-canopy forests and will contribute to protecting the riparian environments temporarily. Lengthening the revolution of these stands will also favour the quantity of large trees and dead wood in the riparian environment.

Adapted Forest Regime

Several articles of the adapted forest regime provide for protection of the riparian environment (Chapter 3 of the Agreement Concerning a New Relationship Between Le Gouvernement du Québec and the Crees of Québec).

[1] To learn more about the concept of residual forest, refer to the “Spatial Organization” section.

1.6 WETLANDS

1.6.1 BACKGROUND

Wetlands (are sites saturated with water or flooded for a long enough period to influence the nature of their soils or the components of their vegetation. They include shallows (< 2 m), marshes, swamps and peatlands.

Wetlands perform essential ecological functions for the proper functioning of ecosystems. Some environments contribute to water filtration by promoting the deposition of sediments, and by limiting the input of nutrients (nitrogen and phosphorus) and metals into lakes and watercourses The high-water retention capacity of certain environments promotes flood control and mitigates the harmful effects of water movements on the territory (erosion and flooding). The accumulation of biomass in peatlands helps mitigate climate change by storing the carbon that it contains for long periods of time. Wetlands also support a particular plant life and wildlife composition, some species of which are considered threatened or vulnerable in Québec. Isolated wetlands are often less frequented by predators and can play an important role during the breeding season, especially in the spring.

Several provisions are included in the Regulation respecting the sustainable development of forests in the domain of the State (RSDF) and in the Regulation respecting wildlife habitats (RWH) to preserve the integrity of wetlands in riparian zones. The RSDF protects open peat bogs with ponds, marshes and riparian treed swamps by prohibiting forest development and requiring the maintenance of a 20 m wooded strip. Certain riparian wetlands are also protected by maintaining a 20 m riparian wooded strip on the edge of lakes or permanent watercourses (see “Riparian Areas”). Moreover, no harvesting can be done on certain types of riparian treed swamps due to their rarity province-wide. However, some concerns remain regarding forested wetlands, isolated open wetlands or without ponds and temporary ponds. Practices such as mining, energy and forestry can compromise wetland diversity and integrity (e.g. altered hydrology, fragmentation, loss of connectivity). The protections offered by the large protected areas are not designed to preserve specific sites, but rather to establish a network of protected natural environments representative of the territory. For these reasons, additional measures must be taken locally to complete the protection of wetlands in order to ensure that the specific ecological functions of certain wetlands with high ecological value will be maintained.

To learn more, consult:
Booklet 6.2 - Issues related to wetlands

1.6.2 LOCAL ANALYSIS OF ISSUES

The issue analysis approach consists of checking that sufficient protections are in place to prevent the disappearance or deterioration of wetlands of high ecological value. Conservation value is inferred based on their rarity, extent, diversity, integrity or quality of habitat and ecological services.

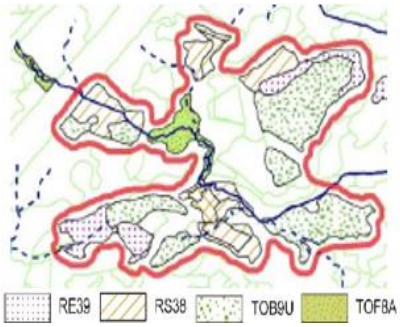
1.6.2.1 Criteria

In general, we recognize wetlands as including shallows, marshes, swamps and peatlands. The ecoforest map can be used as basic information to draw up the table of wetlands from the ecological type or the land code.[1]

Table 23: Wetland Types

Wetland Types	Definition[a]
Shallows	Wetland characterized by the presence of permanent shallows (often less than 2 m deep), stagnant or flowing water. Flooding of the environment can fluctuate annually or daily depending on the body of water to which the environment is connected. The soil is rich in nutrients. There are floating or submerged plants.
Marsh	Unforested wetland, permanently or irregularly flooded, dominated by emergent herbaceous plants, partially or completely submerged during the growing season.
Swamp	Wetland dominated by ligneous shrub or tree vegetation (4 m or more in height) covering more than 25% of the area and growing on mineral soil (gravel, sand, silt or clay). These lands are subject to seasonal flooding or characterized by a high water table and a circulation of water enriched with dissolved minerals.
Peatland	Wetland with poor or very poor drainage where peat (organic soil) accumulates faster than it decomposes and reaches a thickness of more than 40 cm. Some Peatlands have tree cover (stems over 4 m high) equal to or greater than 25%, while others are open (unforested). Peatlands fed only by rainwater are called ombrotrophic (syn.: bog), while those that can also benefit from circulation of water from the drainage basin enriched in minerals are called minerotrophic (syn.: fen).

The location of wetlands in relation to the hydrographic network influences their ecological function and the protection they receive. For example, a swamp subject to flooding helps regulate water flow, filter and retain sediment, and slow shoreline erosion. The riparian or isolated nature of these environments can be known with the ecological type (TOB9L, TOB9N, TOF9L, TOF8N, TOF8A and MA18R) or by analyzing the contacts with bodies of water, watercourses, flooded areas and the ponds.



Wetland "complexes", which are formed by clusters of adjacent wetlands (e.g., located within 60 m), are also of particular ecological interest, the value of which can be characterized. Aquatic environments of small surface area (< 8 ha) can be part of the complex insofar as they are completely isolated. When delineating the complexes, it may be useful to check that the percentage of the area occupied by wetlands and aquatic environments remains dominant compared with that of well-drained terrestrial environments. The selected sites should tend, if possible, toward regular, compact and slightly tapered shapes.

Vernal ponds do not belong to a wetland category, but they can play a role in the survival of several species, including amphibians. These form in shallow depressions (often < 1 m) present in many forest environments. They are isolated from the hydrographic network and supplied with water by

[1] Other information can improve this map (wetland maps produced by Ducks Unlimited Canada, Quebec topographic database, aerial photographs).

precipitation, snowmelt or the water table. They retain water in the spring for a period of about two months, and then dry up during the summer.

Vernal ponds must be analyzed separately, since most of these environments are not listed on ecoforest maps due to their size, which is often below the detection limits of photo interpretation. They are also difficult to detect in the field during harvesting, when they are generally dried up or hidden under snow. The analyst who has data collected from wildlife managers and users may choose to draw up a preliminary profile of the territory's vernal pools. The use of orthophotographs taken in the spring and the performance of reconnaissance activities in the field could improve the profile. Up to now, there has been no special work for this type of environment in the region. The work performed in other regions implies that small vernal ponds could be fairly abundant and their increased rarity or loss is unlikely. For the biggest vernal ponds, the development of new approaches by teledetection will allow us to identify them better in the future.

1.6.2.2 Characterization

An assessment of wetlands that benefit from protection through the creation of protected areas or regulations will provide a better knowledge of the threats these environments may face. In doing so, it will be possible to identify deficiencies in the protection of wetlands of great value due to their rarity and their particularities.

Table 24: Criteria for Assessing Wetlands of High Ecological Value

Criteria	Precision
Rare environments	Assessing the frequency and relative area of wetlands makes it possible to diagnose of their rarity. The wetland types individually covering less than 1% of the territory will be chosen as rare types.
High-Integrity Environments	Wetland little disturbed by human activity and presenting exemplary characteristics with regard to its extent or the continuity of its natural habitats. Some integrity indicators can be assessed for individual wetlands, but are primarily intended to be applied to “complexes”.
Habitats that support species of great importance	Environments constituting an essential habitat for the conservation of one or more threatened or vulnerable plant or animal species. This category can also be extended to wildlife habitats legally protected under the *Regulation respecting wildlife habitats*.
Ecological service environments	Environments that provide essential ecological services, such as the presence of a specific wildlife site, the presence of a floodplain that reduces intense flood events downstream, the protection of a drinking water source downstream, etc.

When wetland complexes exist, particular attention must be paid to their size, the diversity of communities (number of different wetlands), the rare elements they contain and the integrity of these environments.

1.6.2.3 Analysis Scale

The spatial scale to be used for the analysis of wetlands corresponds to the perimeter of the Management Unit, including protected areas and landlocked territories. A cluster of Management Units could also be used, to the extent the chosen territory allows clear identification of the issues particularly

concerning rare wetlands. The territory selected must include all tenures (protected or not), without consideration for the uses, operational constraints and productivity of the forest land.

1.6.3 CURRENT STATE

Tables 25 and 26 allow verification of the abundance of different wetlands and wetland complexes, including isolated wetlands, and the range of environments currently protected.

Table 25: Area in Wetlands and their Representativeness by MU

Type of environment		Wet barrens	Marsh and swamp[1]	Cedar stand[2]	Black Spruce-sphagnum stand[3]	Wet Balsam Fir stand[4]	Ombrotrophic bog[5]	Minerotrophic bog[6]
2661	Ha		3,744		196,242	1,288	56,800	5,603
	%		1.4		74.4	0.5	21.5	2.1
2662	Ha		2,555		90,617	356	22,831	2,830
	%		2.1		76.0	0.3	19.2	2.4
2663	Ha		1,946		95,100	955	37,362	3,834
	%		1.4		68.3	0.7	26.8	2.8
2664	Ha		2,056		131,651	2,248	30,897	2,611
	%		1.2		77.7	1.3	18.2	1.5
2665	Ha		4,207		121,245	385	29,445	1,448
	%		2.7		77.4	0.2	18.8	0.9
2666	Ha		2,361	8	69,295	4,598	10,460	2,520
	%		2.6	0.0	77.6	5.2	11.7	2.8
8551	Ha		13,502		336,496	10,271	117,617	14,815
	%		2.2		55.2	1.7	19.3	2.4
8562	Ha		2,450		56,972	95	22,823	2,101
	%		2.9		67.4	0.1	27.0	2.5
8652	Ha		5,800		134,224	4,380	21,209	3,348
	%		3.4		79.4	2.6	12.6	2.0
8663	Ha		5,537		174,681	1,340	39,146	5,399
	%		2.4		77.3	0.5	17.3	2.4
8664	Ha		5,306		106,733	1,917	20,012	6,510
	%		3.8		76.0	1.4	14.2	4.6
8665	Ha		3,370		83,030	7,923	7,676	4,243
	%		3.2		78.2	7.5	7.2	4.0
8666	Ha	7	3,931		115,665	1,597	23,912	5,390
	%	0.0	2.6		76.3	1.1	15.8	3.6
8751	Ha		6,923		114,660	8,931	19,000	1,446
	%		4.6		76.0	5.9	12.6	1.0
8762	Ha		4,974		107,000	3,046	22,574	3,918
	%		3.5		75.6	2.2	16.0	2.8
8763	Ha		7,154		89,434	5,923	5,191	1,620
	%		6.5		81.8	5.4	4.7	1.5
8764	Ha		5,219		99,837	3,419	7,171	3,401
	%		4.4		83.9	2.9	6.0	2.9

[1] Freshwater marsh or swamp: MAxx
[2] Cedar stand: RC38
[3] Black Spruce-sphagnum stand: RE37, RE38, RE39
[4] Wet Balsam Fir stand: RS18, RS37, RS38 et RS39
[5] Ombrotrophic bog: TOB9
[6] Minerotrophic bog: TOF8

Table 26: Wetland (WL) Protection Profile for Each MU

	Areas (ha)				Protection		
MU	Wetlands	MU	WL protected in the RAPQ	Other WL excluded from harvesting	Ratio of protected WL (%)	Ratio of MU protected due to WL (%)	To be filled (ha)
2661	263,676	1,335,282	54,848	36,241	20.8	6.8	0
2662	119,189	550,829	11,099	3,939	9.3	2.7	0
2663	139,197	496,644	75,221	17,007	54.0	18.6	0
2664	169,463	638,808	18,498	18,366	10.9	5.8	0
2665	156,729	490,998	3,209	34,076	2.0	7.6	0
2666	89,242	320,068	1,208	0	1.4	0.4	1,992
8551	609,783	1,043,042	46,448	344,872	7.6	37.5	0
8562	84,490	133,428	25,030	78,868	29.6	77.9	0
8652	168,961	389,749	6,549	83,571	3.9	23.1	0
8663	226,103	381,633	91,183	207,678	40.3	78.3	0
8664	140,479	292,812	2,631	72,370	1.9	25.6	0
8665	106,242	358,844	10,599	16,391	10.0	7.5	0
8666	151,556	515,580	52,303	25,782	34.5	15.1	0
8751	150,960	544,128	21,840	0	14.5	4.0	0
8762	141,513	466,822	2,929	0	2.1	0.6	1,739
8763	109,323	442,397	16,719	0	15.3	3.8	0
8764	119,048	434,587	1,857	0	1.6	0.4	2,489
Region 10	2,945,954	8,835,653	442,171	939,163	15.0	15.6	

1.6.4 OBJECTIVES

The objectives pursued with respect to wetlands are to ensure that sufficient protections are in place to see to the maintenance of the ecological functions of high-value wetlands and isolated wetlands.

In order to complete the protection in place and to alleviate human pressure on the most vulnerable or remarkable types of wetlands, additional sites have been identified as wetlands of interest (WLI).1

It is recommended to establish new protections based on the following benchmarks:

- a maximum of 1% of the area of the territory must be covered by sites proposed as wetlands of interest **to ensure that at least 1% of the baseline territory presents measures allowing protection of wetlands (protected areas and other administrative protection measures included)**;

[1] New protected area status granted to the legal recognition of small natural sites specially designed to preserve wetlands of interest on forest lands in the domain of the State.

- wetlands of interest combined with wetlands included in protected areas **or other protective measure** represent at least 12% of the total area of wetlands in the territory.

In so doing, the wetlands of interest enhance the current protection offer, while contributing to the overall effort to ensure that wetlands are fairly represented as natural environments in the network of protected areas. The shortage is defined by the variance from the area equivalent to 12% of the wetlands of the baseline territory up to a limit of 1% of the baseline territory. To this effect, the sectors of interest in the region are MU 2666, 08762 and 08764, which will be protected in the form of WLI during the 2023-2028 period.

1.6.4.1 Exclusion

Wetlands are recognized as unique and irreplaceable natural sites. Maintaining them in their natural state, before they are too altered by human activity, is preferable and more economical than restoring them. The concept of wetlands of interest has therefore been put in place to ensure the conservation of environments of high ecological value and of great importance for the maintenance of biodiversity or the quality of their ecological services.[1] The selection of areas of wetlands of interest to be achieved for each baseline territory should be oriented in order of priority toward:

- naturally rare wetland types;
- wetland types threatened with increased rarity due to human activities (certain types of exploitable peatlands, in particular);
- wetlands that are home to threatened or vulnerable species or other fragile elements;
- wetland complexes comprising sites selected in the previous stages;
- wetland complexes that stand out in terms of diversity and integrity, and then those that provide ecological services that are useful to society;
- in the presence of complexes of the same value, the analyst will seek to them so that they are equitably distributed among and within the watersheds.

The regionally inventoried wetlands of interest are taken over in the layers of forest uses as administratively protected sites so they are excluded from any forest management activity. Eventually, proposals of wetlands of interest adopted in the PAFITs could be included in the Registre des aires protégées au Québec (Register of Protected Areas in Québec).

Stay tuned!

Developments are expected in the coming years regarding the inclusion of wetlands of interest in the Registre des aires protégées [Register of Protected Areas].

[1]Wetlands located in protected areas cannot benefit from additional legal status. However, wetlands of interest may include areas subject to regulatory or administrative protection so that they can be recognized as such and facilitate monitoring.

1.7 LOCAL ISSUES

In the Nord-du-Québec region, two types of sites include obstacles to forest productivity and must be given special attention. These are sites susceptible to:

- invasion by ericaceous plants;
- paludification.

1.7.1 PALUDIFICATION (MU 08551, 08562, 08652, 08663, 08664, 08665)

The paludification process is explained by the prolonged absence of severe disturbance on a flat topography and/or impermeable soil. Over time, opening of the softwood stand changes the quantity of light transmitted to the soil. This change leads to a succession among mosses. There is a gradual progression from shade-tolerant mosses to shade-intolerant sphagnums increasingly resistant to decomposition. The succession of mosses influences the forest soil, which becomes increasingly cold and wet. Gradually the water table rises and renders nutrients difficult to access. Throughout the process, the input of nutrients in the trees decrease and the growth conditions deteriorate, which alters the productivity of the stand.

The objective is to ensure maintenance of the yield of forest stands that are susceptible to paludification or paludified.

The risk of not performing sustainable management in these MUs is assessed on the basis of two factors: accessibility and the level of paludification of the stand. The ecological types (RE26, RE37, RE38 and RE39) are indicators of the paludification level and allow assessment of the probability of success with land preparation. The probability of success is high in RE26 and gradually decrease to a near-zero probability in RE39. The accessibility of the stands influences the options for resumption of production and the profitability of operations. Consequently, zoning was developed to manage the risks related to paludification:

- Paludified landscapes are large sectors where there is a concentration of paludified stands and to which access is possible only in winter due to the water regime and the low availability of materials for road construction. Operations in these landscapes would be below the breakeven point and almost impossible to carry out. No forest operation should be performed in paludified landscapes. For the 2023-2028 period, the contribution of the paludified landscapes to the allowable cuts was excluded (see the thematic sheet of the Bureau du Forestier en chef: https://forestierenchef.gouv.qc.ca/wp-content/uploads/Paysages-paludifies.pdf).
- Paludified stands (or stands susceptible to paludification) accessible from outside the paludified landscapes must be the priority for sylvicultural treatments such as scarification and planting because there is less uncertainty regarding the effectiveness of these scenarios. Scarification (1 or 2 passages) can be done by T26 or harrow, depending on the site. Because a harrow is more efficient where the organic material is thicker, but also useful to reduce competition with ericaceous plants, it should be prioritized most of the time. Planting should be at 2,000 stems/ha to reform the forest cover as quickly as possible so that this stand as a competitive advantage over mosses and sphagnums. Outside the woodland caribou habitat, Trembling Aspen (PET)

stems should be maintained when this species is already found on the site. Planting with a certain proportion of Eastern Larch (Tamarack) (MEL) may be done particularly on hydric sites.

- For paludified stands (or stands susceptible to paludification) inaccessible outside paludified landscapes, depending on their location, the productivity and the maturity of the neighbouring stands, the planner must choose whether it is strategically relevant to develop access for harvesting and restoration of production of these stands. If this is the case, the most effective solutions will be chosen (scarification and plantation), accounting for the necessary investment in construction of a Class 4 or 5 road (not a winter road). These choices must be made diligently, due to the fact that the assessments performed with MÉRIS show that this types of investment is unprofitable for a large part of the sites concerned. If the development of an access is not considered relevant, these stands will follow the silvicultural scenario provided in the allowable cut calculation or will be the object of land preparation in winter with solutions that are usually more expensive and less efficient. Development of innovative solutions is still possible and will be explored for the 2023-2028 period.

For more information, see the forest management levels in the PAFIT section (Template 4) and the issue-solution sheet on the subject in the appendix.

1.7.2 INVASION BY ERICACEOUS PLANTS (MU 02661, 02662, 02663, 02664, 02665, 02666, 08652, 08664, 08665 AND 08666, 08751, 08762, 08763, 08764)

After cutting, in certain forest types, removal of the cover creates conditions favourable to invasion by ericaceous plants, species that seek light (heliophilic). These shrubs mainly harm Spruce by hindering its growth. The decrease in growth mainly seems to be caused by the developed and extensive root system of ericaceous plants, which assures them of a competitive advantage over Spruces for absorption of nutrients. The litter produced by ericaceous plants, which does not decompose easily, also contributes to reduce the availability of nutrients. The objective for the MU group is to ensure maintenance of the yield of forest stands that are subject to invasion by ericaceous plants.

The Bureau du Forestier en Chef, in its allowable cut calculations, establishes a period of 25 years after cutting for the return of mature forest strata. This growth period causes delays in the availability of timber for harvesting and thereby reduces the allowable cut in the territory. For more information, see sheet 4.1 of the Chief Forest on ericaceous plants in the “Manuel de détermination des possibilités forestières 2013-2018” (Manual for determining allowable cuts 2013-2018).

The problem stations are the following ecological types: RE12, RE20, RE21, RE22, RE37. Ecological type RE37 is also associated with the paludification problem. For the Management Units targeted by the forest management strategy for the paludification problem (MU 08551, 08562, 08652, 08663, 08664, 08665), ecological type RE37 will not be treated by the forest management strategy related to the problem of ericaceous plants. Ecological type RE12, associated with ericaceous plants and Caribou Lichen (Cladonia) forest stands, is the subject of a section in the RSDF, prohibited interventions if they are located in the area of application of the Woodland Caribou Recovery Plan produced by the Woodland Caribou Recovery Team of Québec. The Chief Forester’s calculations exclude all forest areas covered by regulatory or legal channels that prohibit logging. Thus, no forest management

strategy will be recommended for this ecological type located in the area of the caribou recovery plan. However, it may be developed outside the limits of this area.

With the opening of the forest canopy and increased sunlight conditions, ericaceous plans have a rapid propagation capacity after cutting. It is important to limit, slow or eliminate this colonization of the cutovers by ericaceous plants in order to give the seedlings every opportunity to reach a height of one metre. At this height, the inhibiting effect of ericaceous plants no longer limits tree growth.

When high regeneration is present in an acceptable density for the next stand, the opportunity to perform a cutting with high regeneration and soil protection should be seized, even though the Chief Forester currently applies the same regeneration periods in this type of treatment. On the other hand, when regeneration is insufficient for form a merchantable stand at maturity, cutting with regeneration and soil protection, followed by full land preparation with hydraulic disc equipment or by harrowing should be prescribed.

When there is ambiguity whether or not to perform land preparation, the following criteria will be assessed to guide the forest manager's decision:

- The profitability of the operations is related to the accessibility of the site. When a stand susceptible to invasion by ericaceous plants is accessible, the treatment should be performed because the return on investment is very probable.
- The profitability of the operations is related to the transportation distance. When a stand susceptible to invasion by ericaceous plants is near a plant, the treatment should be performed because the return on investment is very probable.
- The social acceptability associated with land preparation is also a criterion to consider. If acceptability is present in the sector where the stand susceptible to invasion by ericaceous plants is found, the treatment should be performed.

Obviously, other issues necessitating the use of the silvicultural budget must be taken into account. The added value to be realized by land preparation, followed by tree planting for the stand susceptible to invasion by ericaceous plants and the added value of investing in a solution for another issue. When asking these questions, it must be kept in mind that a 25-year growth period must be avoided whenever possible, but that despite the absence of land preparation, the stand nonetheless will contribute to the allowable cut in the long term, which is not the case for a paludified stand, for example. Another example, in the territories envisioned for the Woodland Caribou strategy, the investment to build an access road to the stand and perform land preparation followed by reforestation might not be advantageous, if it is considered that the stand will have to be closed again to ensure to ensuring recruitment of a forest stand with little fragmentation.

For more information, see the forest management levels in the PAFIT section (Template 4) and the issue-solution sheet on the subject in the appendix.

1.7.3 MAIN INFRASTRUCTURE AND ACCESS ROADS

1.7.3.1 Access Road Management Plan

Management of access roads is a key factor for reduction of the environmental impacts associated with forest management. Indeed, the forest road network influences, in particular, the quality of fish habitat and wildlife habitats, particularly that of Woodland Caribou. The preparation and implementation of an access road management plan represents a complex and colossal task. To obtain public adherence by a common understanding of the values and issues related to the forest road network, progress will be gradual and will necessitate the collaboration of all MRNF partners and their partners. Given the gradual implementation of the Strategy for Woodland and Mountain Caribou, announced in April 2019, the priority will be given to the territory used by this species. Over the years of collective work, the attributable forest of the Nord-du-Québec region will be covered completely by an access road management plan.

The preparation of the access road management plan will be organized around values of the public and the MRNF's partners. For the time being, the forest management values and objectives related to the forest road network, presented in the table below were identified from the discussions of the Local Integrated Resource Management Planning Panels (TLGIRT), consultation and harmonization meetings and the 2018-2023 PAFIT consultation.

In the territory of application of the adapted forest regime of the Paix des Braves, the development of the road access network has been very important. Several rules already apply, which are described in Chapter 3 of the Agreement. These rules will also be taken into consideration in the preparation of the access road management plan.

The information presented in Table 24 is subject to improvement. The PAFIT exercise is an opportunity to add values and/or refine the forest management objectives.

Table 27: Community Values Associated with the Access Road Network and Forest Management Objectives Related to These Values

Values	General forest management objectives
Public safety	A forest road network ensures and acceptable level of public safety.
Fish habitat	A forest road network with watercourse crossings that do not hinder the free passage of fish.
Protection of spawning grounds	Planning long enough in advance to allow consultation and verifications in the field.
Water quality	A forest road network that limits erosion and sedimentation events.
Maintain the Woodland Caribou habitat	A forest road network of limited extent in the Woodland Caribou habitat, which restricts fragmentation of habitats and the disturbance rate.
Traditional way of life	A forest road network that favours the accomplishment of the traditional way of life.
Optimum access	A forest road network that ensures the accessibility of the region's various attractions without presenting redundancy.
Economic development	A forest road network that allows forest, mining, energy, hunting, fishing, trapping, NTFP harvesting and tourism activities.
Predictability of operations	Know the harvesting operations to come in the medium term (5 years) in order to invest when a return on investment will be possible.
Visual quality of landscapes	A forest road network that maintains the visual quality of the landscape during hiking, canoeing or other activities.

A detailed action plan was written to specify the approach the MRNF will follow for the preparation and implementation of its Access Road Management Plan. The pivotal actions of the approach are:

- identification of the basic network, access roads necessary for maintenance of land rights (vacation properties, land occupancy) and economic activity related to natural resources (forestry, energy, mining, NTFP);
- identification of zones in relation to the territory's values and association of specific road network development objectives.
- identification of road closing opportunities and opening scenarios, followed by closing to limit expansion of the network.
- compliance with the normal process provided in the Guide des demandes de fermeture de chemins multiusages (Guide to multipurpose road closing requests) for each closing project.

At each stage, a presentation to the TLGIRTs is planned to favour regional cohesion. For the time being, the action plan does not address network maintenance. This factor may be explored in a 2nd phase, if necessary.

2. Timber Production Issues

The Québec Timber Production Strategy relies on a forest management approach based on improving the characteristics of trees (their quality[1]) in order to better meet the needs of industry and markets, as well as increasing the quantity of timber available, harvested and processed. The combination of these two elements (quality and quantity) defines the value of the wood available for harvesting.

As provided in the Québec Strategy, the Directions de la gestion des forêts (DGFo) prepared a Regional Timber Production Strategy responding to the regional issues identified in collaboration with the regional stakeholders, particularly the forest industry operators. Given that the Integrated Forest Development Strategy is the result of a compromise accounting for the issues related to the three spheres of sustainable development, it was decided to integrate the regional strategies directly into the Integrated Forest Management Plans (PAFI).

The section below will a profile of the gap between supply and demand on the regional scale, as well as the timber production issues of timber production retained by the DGFo. The objectives and the forest management choices are presented in the *2023-2028 Tactical Integrated Forest Management Plan* documents for the Nord-du-Québec region.

2.1 GAP BETWEEN SUPPLY AND DEMAND

The profile of the gap between supply and demand is an important input in the process of identifying the issues related to timber production since it makes it possible to assess whether the current supply meets the needs of forest industry operators in terms of quantity and quality by species or species groups. It also makes it possible to assess whether all of the timber volumes produced by the forest on the territory of the Management Units and planned by the MRNF local offices (UG) with regard to the targets of the management strategy and the management objectives, are harvested by rights holders and, where appropriate, identify solutions to promote harvesting in the short, medium and long term.

When the forest development strategy and the allowable cuts are assigned on the Management Unit scale, the supply guarantee (GA) volumes are attributed on the regional scale, to offer greater flexibility as to the origin of timber in the domain of the State. The regional scale was chosen to analyze the gap between supply and demand and to have a common basis for the comparison of all the variables.[2]

In order to identify the issues related to the management of supply and demand, it is important to understand the difference between the main terms used to describe the volumes of wood and their quality. The tables below present a definition for each of them.

[1] Timber quality is defined mainly by its mechanical properties, the quality of its fibre and its appearance.
[2] Additional analyses from the data available at the MU can be carried out as needed to detect issues that may arise at this scale.

Table 28: Terms Used to Qualify Timber Volumes

Term	Definition
Gross allowable cut	Corresponds to the volumes calculated by the Bureau du Forestier en chef (BFEC) for each Management Unit and residual forest area. These figures are presented by the Chief Forester (CF) when determining the allowable cut.
Net allowable cut	Corresponds to the BFEC allowable cut to which the Direction de la gestion de l'approvisionnement en bois (DGAB) of the Ministère des Ressouces naturelles et des Forêts (MRNF) applies reductions (decay, saw cuts, hardwood bucking scraps and correction for the difference in definition of gross merchantable volume between the decennial inventory and the scaling standards). These values are taken from the provincial matrix applied to forecast harvest stock tables.
Attributable Volume	Corresponds to the net allowable cut from which the DGAB, in cooperation with the DGFo, subtracts volumes that cannot be subject to forest rights due to requirements related to forest certification, the terms of the Paix des Braves, the terms administration, stratum freezes, firewood harvesting or certain government commitments.
Attributed volume	Corresponds to the attributable volume (in whole or in part) that is subject to forest rights.
Harvested volume	Corresponds to the timber volume harvested and measured, which also includes unused ligneous materials.

Table 29: Terms Used to Qualify Timber Quality

Category	Element	Description
Transformable volume	Peeling	Volume of logs deemed fit for peeling.
	Sawmills	Volume of logs deemed fit for lumber or sawable (short logs). Depending on the species, different lumber qualities are considered (lumber, F1, F2, F3, F4[1]).
	Pulp	Volume of logs deemed fit for pulpwood.
	Other	Volume of other products (e.g.: post, shingle).
Unprocessable volume	Merchantable branches	Branches from the last forks whose diameter at the end at a distance of 1 metre from the fork is at least 9 cm on bark. [2]
	Saw cuts	Proportion of gross merchantable volume reduced to sawdust during harvesting and cutting operations. The proportion being considered is 1%.
	Inventory adjustment	Relative difference in gross merchantable volume between the definition of the inventory and the measurement concerning the minimum diameter of use[3]. The relative reduction to be made varies according to the species and the diameter at breast height (DBH) of the trees.
	Scrap	Cutting residue deemed unfit for processing.
	Decay	Timber volume considered unfit for processing due to deterioration resulting from the activity of fungi which alter its weight, colour, texture and strength.

Source: MFFP (2018)

[1] The Petro grading is a classification of hardwood logs, developed in Quebec by Petro and Calvert 1976). The F1, F2 and F3 classes correspond to the Petro classes from the classification of hardwood logs, and the F4 class corresponds to the addition, by the MRNF, of a "short-log" class during the cutting studies carried out during of the 2000s.

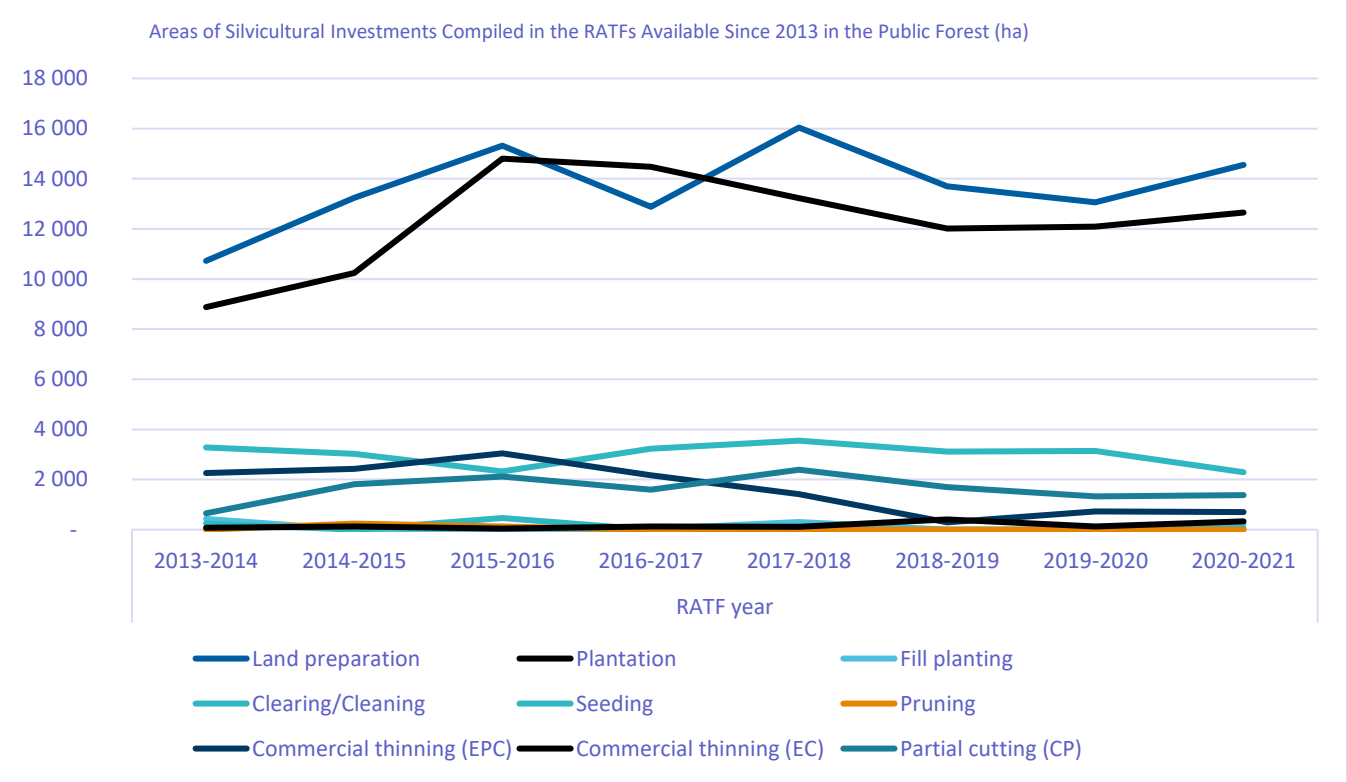
[2] Even if the merchantable branches are normally part of the attributable volume, they are generally not transported to the factory and enhanced. For this reason, they have been classified in the non-transformable volume.

[3] In the timber scaling instructions, 9 cm over bark in the inventory vs. 9 cm under bark.

2.2 ASSESSMENT OF PAST SILVICULTURAL INVESTMENTS

The assessment of the areas having been the subject of silvicultural investments on the territory of the Management Units of the region shows the efforts deployed for the establishment and education of regeneration and its state. It also allows assessment of whether the investments realized made it possible to achieve the silvicultural objectives concerned and obtain the desired yields in volumes, species and quality. Based on the findings, the DGFo can proceed with adjustments to maximize the economic and financial profitability of the investments and achievement of the silvicultural objectives concerned. These findings also can guide the forest manager in identifying timber production issues and means to be deployed to correct the situation in the future.

The data used comes from the technical and financial activity reports (RATF) and is broken down by type of silvicultural treatment. Figure 8 presents the annual report of the areas in hectares having been the subject of silvicultural investments in the territory of the Management Units of the Nord-du-Québec region since 2013.



Source: RATF 2013-2020

Figure 8: Assessment of the Areas (ha) Having Benefited from Silvicultural Investments on the Territory of the Management Units of the Nord-du-Québec region

In general, the fulfilment of the silvicultural strategy achieves the established objectives. Nonetheless, certain work does not meet the projected targets, particularly commercial thinning and the various stand tending work. In the case of commercial thinning, this situation is mainly due to the gradual availability of eligible stands over time. Indeed, since the target is an average of the availability over the next 25 years, it is difficult to meet the targets projected at the beginning of the period. This situation will be

corrected for the 2023-2028 period, while the target will be based on the average of the next 10 years. Other factors are also added to explain the difficulties of meeting the targets, such as the low profitability of the work, the difficulty of finding stands with the minimum prescription criteria in the field, and the availability of adapted machinery. Concerning stand tending (clearing, cleaning and pre-commercial thinning), the availability of eligible stands in the field in several MUs is less than the targets provided.

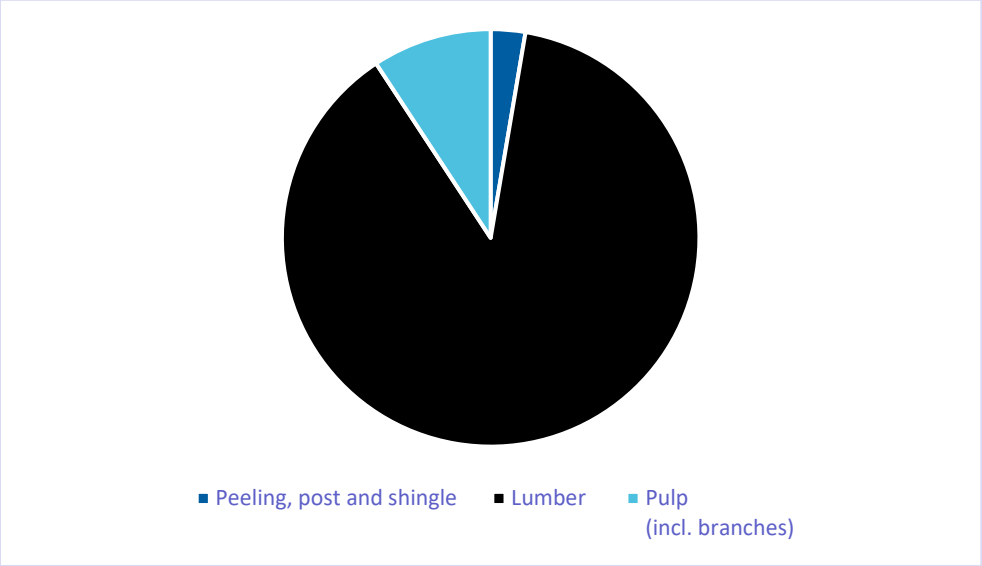
2.2.1 PROFILE OF THE SUPPLY

The timber supply corresponds to the net allowable cut of any so-called commercial species, whether or not it currently finds buyers. This is the potential timber that can be harvested sustainably from the Management Units in the region. The table and figure below present a breakdown of timber supply at the regional level by species or species group and detailed according to the estimated quality class (peeling, lumber, pulp and others).

Table 30: Distribution by Species or Species Group of the Quality Class of the Net Allowable Cut Forecast for the Territory of the Management Units of Region 10 for the Quinquennial Period 2018-2023

Species or species group	Quality class (m^3)				TOTAL
	Peeling, post, shingle	Lumber	Pulp	Other	
FSPL	2,550	3,473,250	-	-	3,475,800
Eastern White Cedar	-	150	300	-	450
Poplars	106,850	129,950	239,100	-	475,900
Paper Birch	1,000	29,450	142,000	-	172,450
Maples	-	-	100	-	100
TOTAL					

Source: DGAB



Source: DGAB

Figure 9: Breakdown of Timber Supply Volume (m^3) by Quality (Region 10)

The breakdown of the timber supply volume based on quality (peeling, lumber or pulp) is determined by species and the characteristics of the stem (e.g. diameter, taper, nodosity, decay). Depending on the quality of the harvested stems, plants specialize in processing them into many products. The Regional Timber Production Strategy (RTPS) and the silvicultural work will be influenced by the specific demand of the plant categories.

Table 30 and Figure 9 show that:

- the peeling, post and shingle quality volumes, which generally present more economic value than the other qualities, are relatively low. The region's more northern conditions are among the factors that explain this;
- the lumber quality volumes are in the majority. It is important to mention that even if the FSPL stems are generally directed to the sawmills, pulp quality applies to the stems that are too small;
- the pulp quality volumes, although generally of lower value, meet the demand and are relatively high.

The assessment of the silvicultural work performed and the future work influences the allowable cut and the distribution of the breakdown of timber supply volume according to the quality presented below.

2.2.2 PROFILE OF THE DEMAND

Timber demand corresponds to the consumption needs of regional primary processing plants and those located outside the region that obtain their supplies from the regional territory. This profile presents the processing capacity of primary processing plants, their average annual consumption by industrial sector, as well as the contribution of volumes from the Management Units compared with volumes from private forests. It also presents the results of the areas that have been harvested by regeneration cutting and by partial cutting since 2013.

Table 31: Average Annual Processing Capacity of Primary Processing Plants in the Region in 2019 (m³/year)

Industrial sector	Annual softwood volume (m³/year)	Annual hardwood volume (m³/year)		TOTAL volume (m³/ha)
		Poplars	Hardwoods	
Pulp, paper and panels	-	-	-	-
Sawn lumber, veneer, turning, plywood, shaping	3,098,600	1,000	1,005	3,100,605
Other	-	-	-	-

Source: DDII, MFFP database.

Table 32: Average Annual Consumption of Primary Processing Plants in the Region and Outside the Region for the 2014-2019 Period (m³/year)

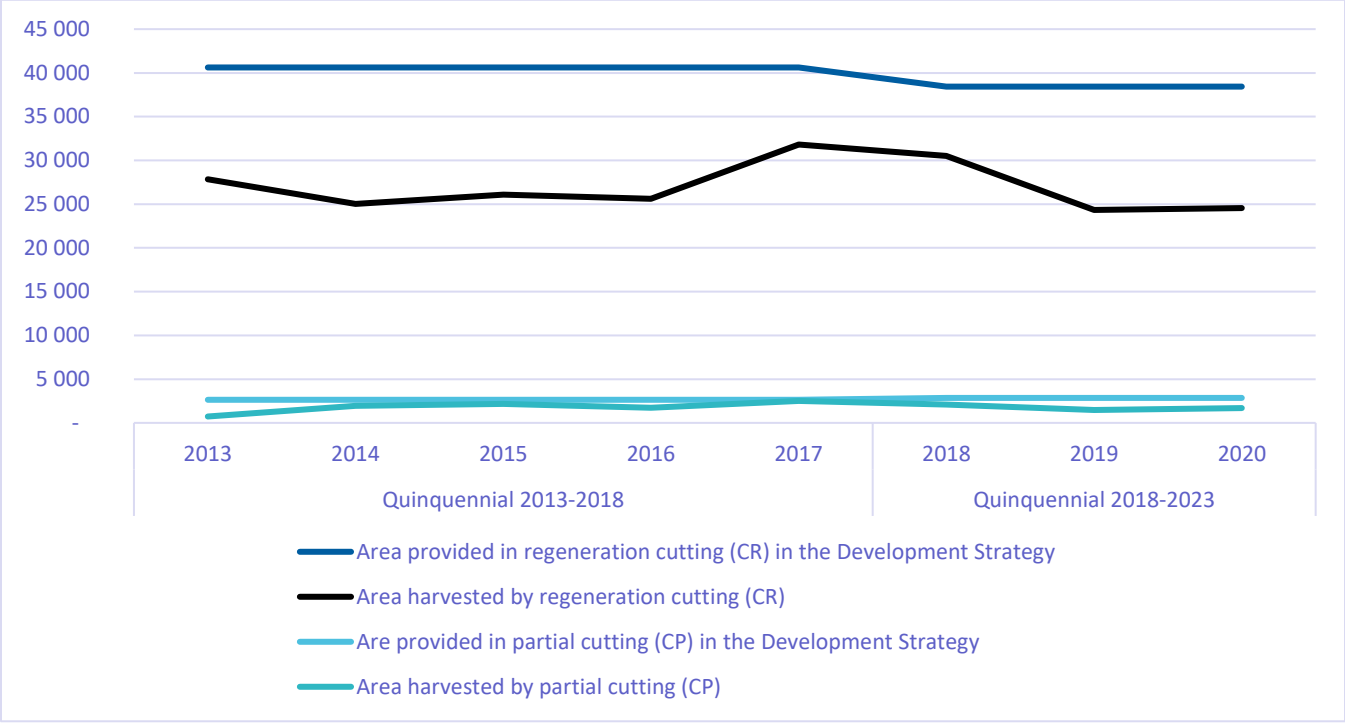
Industrial sector	Average annual softwood volume (m³/year)	Average annual hardwood volume (m³/year)		Total average annual volume (m³/ha)
		Poplars	Hardwoods	
Pulp, paper and panels	-	-	-	-
Lumber and other	2,535,472	241	-	2,535,686
…				

Source: DDII, MFFP database.

The supply of certain plants may come from territories outside the region. However, the timber production strategy seeks to produce more timber in the region to meet the demand. The supply territories are primarily the Management Units in public forests, through timber harvesting permit holders for the purposes of supply of a wood processing plant (PRAU); volumes coming from the free market (auctions by the BMMB); and supply guarantees (GA).

The assessment of areas that have been harvested by clearcutting or partial cutting shows the difference between what was planned in the forest management strategy of the MUs and the areas harvested. The areas provided are established to match the volumes determined by the gross allowable cut.

This analysis is an additional input to know if the gap between supply and demand is related to a timber production issue in terms of quantity and quality or if this is more related to problems of the operational constraints or financial profitability of the forest management work. According to the findings observed, the timber production objectives and the means adopted in the PAFITs will be different. Figure 10 shows the results of areas harvested by regeneration cutting and by partial cutting since 2013.



Source: PAFIT and RATF.

Figure 10: Partial Cutting and Regeneration Cutting Areas Provided in the Integrated Forest Management Strategies in Comparison with the Partial Cutting and Regeneration Cutting Areas Harvested Per Year Since 2013 on the Territory of the Management Unit of Region 10

2.2.3 GAP BETWEEN SUPPLY AND DEMAND

In addition to aiming to increase the harvest of available timber volumes, the RTPS should look at reducing the gap between the potential offered by the forest and its actual use. This gap is assessed on the basis of data relating to the net allowable cut (supply) and the volumes harvested (demand).

Table 33 on the gap between supply and demand illustrates the assessment of the average timber volumes [4] harvested annually in the Management Units (MU) of Region 10 in relation to the allowable cut calculated by the BFEC for the 2013-2018 period and the 2018-2023 period.

[4] It should be noted that in the RTPS, the timber volume corresponds to the timber volume without accounting for the volume of merchantable branches.

Table 33: Gap Between Supply and Demand in the Territory of the Management Unit of the Nord-du-Québec Region for the Periods 2013-2018 and 2018-2023

2013-2018 period	FSPL	Eastern Hemlock (Tamarack)	Pines	Eastern White Cedar	Poplars	Paper Birch	Yellow Birch	Maples	Hardwoods	TOTAL
Gross allowable cut	3,599,200	-	100	1,100	501,400	198,600	-	600	-	4,301,000
Net allowable cut	3,326,003	-	-	426	421,888	167,176	-	254	-	3,915,747
Attributable Volume	3,262,763	-	-	409	336,949	117,874	-	173	-	3,718,169
Attributed Volume	3,219,110	-	-		325,460	52,480	-	-	-	3,597,050
Harvested Volume	3,026,931	-	-	-	181,115	5,260	-	-	-	3,213,305
Ratio of harvested volume/net allowable cut	91%	0%	0%	0%	43%	3%	0%	0%	0%	82%
Ratio of harvested volume/attributed volume	94%	0%	0%	0%	56%	10%	0%	0%	0%	89%
2018-2023 period	**FSPL**	**Eastern Hemlock (Tamarack)**	**Pines**	**Eastern White Cedar**	**Poplars**	**Paper Birch**	**Yellow Birch**	**Maples**	**Hardwoods**	**TOTAL**
Gross allowable cut	3,689,300	-	100	800	503,600	187,800	-	200	-	4,381,800
Net allowable cut	3,475,800	-	-	450	475,900	172,450	-	100	-	4,124,700
Attributable Volume	3,269,150	-	-	350	367,800	118,200	-	-	-	3,755,500
Attributed Volume	3,267,250	-	-	200	290,600	30,600	-	50	200	3,588,900
Harvested Volume (2018–2021)	2,733,234	-	-	-	172,808	7,068	-	-	-	2,913,110
Ratio of volume harvested/net allowable cut	79%	0%	0%	0%	36%	4%	0%	0%	0%	71%
Ratio of harvested volume/attributed volume (2018-2021)	84%	0%	0%	0%	59%	23%	0%	0%	0%	81%

The current finding shows that the forest potential is not used in its entirety. The FSPL demand is sustained and regular. During the 2013-2018 quinquennial period, nearly 94% of the attributable volumes were harvested. For the 2018-2023 quinquennial period, according to the average of the years from 2018 to 2021, the harvest currently corresponds to only 84% of the attributable volumes.

The attributable volumes of intolerant hardwood are not completely harvested. On the average, 56% of Poplars and 10% of Paper Birch of the attributable volume were harvested during the 2013-2018 quinquennial period, while currently, these figures are around 59% for Popular and 23% for Birch. This could be explained by the fact that in the majority of the Management Units, these species are considered to have no buyers. Indeed, the current regional industrial structure does not allow their valorization, because they are mostly composed of unwanted species due to the fact there are few outlets for processing. All of the Birch volumes harvested and nearly all the Poplar volumes are consumed outside the region, mainly at the Norbord plant in La Sarre and the Forex plant in Amos, in Abitibi-Témiscamingue.

Harvesting of other softwoods and hardwoods is non-existent in the region. Two factors explain this phenomenon: 1) the allowable cut for these two species groups is very low, situated for the 2018-2023 period at 450 m^3 for other softwoods and 100 m^3 for hardwoods, and 2) the regional industrial sector does not allow their valorization. In the event that a plant outside the region is interested in these volumes the transportation costs then would be higher for consumption of these low volumes.

2.3 SELECTED TIMBER PRODUCTION ISSUES

In addition to the analysis of the gap between supply and demand, it is important to mention that the production issues were identified through a concerted approach with the external clienteles operating in the territories of the Management Units. This section presents all of the timber production issues identified by the DGFo.

Based on the analysis of the gaps between the region's supply and demand, it is found that the supply exceeds the demand (consumption by the plants).

2.3.1 FINANCIAL PROFITABILITY

Harvesting of a portion of the volumes offered is unprofitable. Access to the regional supply for a given plant will depend on the revenue relative to the supply costs, the in-plant processing costs and the costs of shipping products to its customers. Because the revenues and costs vary temporally and spatially, profitability is an issue in some circumstances:

- Given the climate and biophysical conditions of Nord-du-Québec, the Maple, Pine and Eastern White Cedar volumes generally are not harvested, because they are too dispersed.
- Part of the softwood volume is located within certain mixedwood stands composed of a high proportion of hardwood species without buyers. When the hardwood volume is unwanted by the hardwood processing plants, despite the volume south by the softwood processing plants, these mixedwood stands are not harvested.
- Salvage of forests affected by natural disturbances often falls into this category, because the timber may be degraded or the forestry conditions are more difficult.

2.3.1.1 Timber Quality

As mentioned in the “Profile of the Supply” and “Profile of the Demand” section, certain species with characteristics sought by the plants can be qualified as star species, because there are “sure values” favouring the achievement of the regional timber production objectives. However, for certain species, the volumes offered do not have the characteristics sought. For example, Balsam Fir and Larch (Tamarack) are less harvested because they present greater constraints to processing than Spruce and Jack Pine.

2.3.1.2 Star Species

Although the aim is to produce timber and create wealth with all species making up the basket of regional forest products, special attention is paid to star species in forest management choices and silvicultural investments. Given the time necessary for the silvicultural actions to respond to the issue, the forest management objectives will seek to **increase the proportion of the stand dominated by a star species** on the suitable sites in the medium and long term.

The star species are the pillars that support almost all of our current industrial structure. They supply large plants and represent significant and strategic volumes, in addition to the major economic impacts for the region.

In order to make the selection, an overall assessment of the species present in the region was carried out with regard to the following criteria:

- Availability of each species (standing volume, history of allowable cuts, allocations and supply guarantees);
- Biophysical potential (e.g., the ability to grow on certain sites);
- Industrial demand and consumption (needs of the plants and harvest);
- Vulnerability to risks associated with climate change, insects and diseases;
- Value of products associated with each species;
- Management effort and success rates of each species.

Table 34: Regional Star Species for Timber Production and Justification of Their Selection

Star species	Justification
Spruce (Black, White)	- Silvicultural potential - Resistance - Qualities for processing - Value generated - Presence of buyers - Strong demand from regional industry operators
Jack Pine	- Silvicultural potential - Resistance - Productivity - Qualities for processing - Value generated - Presence of buyers - Strong demand from regional industry operators
Paper Birch	- Abundance of favourable stations for production - Natural productivity - Diversity of the basket of products - Value generated - Volume available - Presence of buyers
Poplars	- Abundance of favourable stations for production - Natural productivity - Diversity of the basket of products - Value generated - Volume available - Presence of buyers

The other species produced represent interesting avenues for the development and diversification of our economy, but will not have a very significant regional economic impact. The volumes concerned by these species are relatively low or currently less desired by the industry. These niche species are mainly:

- Eastern White Cedar;
- Maples;
- Larch (Tamarack);
- Balsam Fir.

Let us remember that the choice of species to be preferred depends on three spheres of sustainable forest management: the economic issues of timber production concerning supply of the plants, the social issues and the environmental issues. The Integrated Forest Development Strategy considers all of these issues. Although the star species occupy an important place in the strategy, it seeks to develop all species in the region and minimize the variances relative to the preindustrial forest. Let us also note that the choice of species evolves according to the analyses concerning the climate change adaptation strategy now in development.

2.3.2 PLANT CAPACITY

The plants in the region do not have the capacity to process the entire supply, which is a potential niche for a new business or offers an opportunity to an existing plant to adapt better to the available forest. For example:

- The region does not have a primary processing sawmill for Paper Birch (BOP), Maples or other Hardwoods;
- The Eastern White Cedar volumes exceed the capacity of the primary processing plants in the region.

These two issues explain why the supply is not used in its entirety. The RTPS will present solutions to favour harvesting. Moreover, it does prevail over other factors that may also explain the gap between supply and demand or consumption by the plants, such as the decrease in production of the plants caused by a slowdown of residential construction, the softwood lumber dispute, international competition, etc. Although the RPTS, in particular, allows management of the forest so that it responds better to the plants' needs, does not prevail directly over the plant capacity issue. Complementary means are available. One of these is "The Québec forest products industry development strategy", which seeks to improve the plants' performance and adapt the plant to the changes in the market or the forest. Considering that each forest stand is generally composed of several species and that each stem has its characteristics the presence of plants using all of the supply would allow optimization of forest management and create more wealth.

After the analysis of the gap between supply and demand, three issues emerge:

2.3.3 FOREST PRODUCTIVITY

In the Nord-du-Québec region, two types of sites include obstacles to forest productivity and must be given special attention. These are sites susceptible to:

- invasion by ericaceous plants;
- paludification.

Productivity depends on natural variables that allow the forest to produce certain timber volumes, and on silviculture (anthropogenic variables), which increases this productivity (quantity and quality of desired species). As explained in the section Assessment of Past Silvicultural Investments, part of the work provided in the development strategy has not been performed.

Moreover, it may happen that forest monitoring is deficient which does not allow the silvicultural treatments to be performed at the right time to obtain the desired results.

2.3.3.1 Mortality

Beyond forest productivity, the supply would be greater is part of the wood were not dead and unusable by the primary processing plants. For example:

- Losses due to natural disturbances, such as fires, insect epidemics or windthrow (trees blown down by the wind);

- The new risks due to climate change, which affect the condition of establishment and growth of trees or invasive species.

2.3.3.2 Access to the Forests

Certain forests are not currently available, particularly because certain sectors are difficult to access for restoration to production.

The RPTS will present solutions to improve the regional supply, with concern for realizing profitable investments for society.

Two other timber production issues not coming from the analysis of the gap between supply and demand were selected:

2.3.4 ECONOMIC PROFITABILITY OF INVESTMENTS

The MRNF must ensure that its forest investments are profitable for society. The silvicultural work performed must be more effective and efficient in achieving our objectives in relation to what the forest produces naturally.

2.3.4.1 Analytical Approach

The economic results serve to inform decision-making to favour the economic profitability in the silvicultural strategies provided in the integrated forest management plans and influence the allowable cut calculations.

It is important to specify that the acquisition of new knowledge allows continuous improvement of the analysis methodology, adjustment of forest yields and update of the economic costs and revenues considered. Therefore, this may influence the economic profitability level of the silvicultural scenarios over time.

The approach on which the economic profitability analyses are based integrates several concepts, including the baseline scenario, the scenario horizon, the costs and revue, the forest yields and the discount rate.

2.3.4.2 Baseline Silvicultural Scenario

The baseline silvicultural scenario used by the Ministère des Ressouces naturelles et des Forêts in the course of its analyses represents the value generated by the merchantable timber volume produced in the natural forest (without silvicultural intervention) harvested during cutting with regeneration and soil protection of a mature forest stand. The net earnings generate allow estimating of the net economic value attributable to this stand's natural production.

2.3.4.3 Horizon of the Silvicultural Scenario

The horizon corresponds to the duration of the silvicultural scenario, namely the number of years necessary to perform all the treatments. This may be a rotation or revolution period. Because the duration of the silvicultural scenarios differs for each and the objective is to compare them and

schedule them according to their profitability level, the analysis is repeated in perpetuity, in a context of continuous reuse of the soil.

2.3.4.4 Costs and Revenues

The costs correspond to the expenses incurred for the performance of the silvicultural treatments associated with a scenario. The economic revenues correspond to the net earnings for society:

- the merchantable value of the standing timber, which corresponds to the royalty paid to the State to acquire the resource ($/m^3);
- the salary benefit, which corresponds to the supplementary portion of the silvicultural and timber processing sector workers' salaries ($/m^3), relative to the salary they could obtain in other fields based on their experience, their training and the economic text (total salary minus opportunity salary);
- the net earnings before corporate taxes, which corresponds to corporate revenues, including harvesting and processing operations (primary and secondary) minus the operating costs ($/m^3).

Given that a scenario generates revenue over a time horizon, the economic revenues must be assessed so as to obtain a forecast over time. To do this, a trend value is generated to obtain an expected value, which accounts for the historical behaviour and minimizes the variations associated with the significant fluctuations of the economic climate.

2.3.4.5 Forest Yields

To analyze the economic profitability of a silvicultural scenario, it is necessary to estimate the characteristics of the timber resulting from the silvicultural treatments. To upgrade the forest and capture the effect of silvicultural treatments on forest yields, the growth curves developed by the BFEC, the growth models of the Direction de la recherche forestière and the scientific and regional knowledge of the effects of treatments are used.

2.3.4.6 Discount Rate

One of the fundamental principles of the profitability analysis is the importance attached to the timing difference between realization of the investments and generation of the revenues. This aspect is taken into account by the discount rate, which translates the consumers' preference for the present, risk aversion and intergenerational equity.

2.3.4.7 Indicators

To allow scheduling of the economic profitability level of major silvicultural scenarios (investment level) and variable terms (horizon of the scenarios), while considering the forest opportunity cost (forest production without investment), an **economic indicator (EI)** has been developed. This indicator represents the wealth gain in perpetuity for each dollar invested, over the entire time horizon of the silvicultural scenario. It is expressed by the following formula:

Economic indicator = (NPV_{pSc} - NPV_{pBase}) /C_{pSc}

OR

NPV_{pSc}: Discounted revenues in perpetuity – discounted costs in perpetuity of the scenario analyzed

NPV_{pBase}: Discounted revenues in perpetuity – discounted costs in perpetuity of the baseline scenario

C_p: Discounted costs in perpetuity of the scenario analyzed

When the EI is positive, this means the investment generates more wealth in terms of timber production and processing than what would be obtained without investment (baseline scenario). Conversely, a negative EI means the scenario generates a loss relative to the baseline scenario.

The NPV_p/C_p ratio of the scenario analyzed may also be an indicator to consider, particularly when the EI is negative. It corresponds to the ratio of the net present value of the investment relative to the cost generated in perpetuity. It allows assessment of whether or not the investment creates a deficit, without considering its opportunity cost. For example, if the EI is negative and the NPV_p/C_p ratio of the scenario analyzed is positive, we can conclude that our investment does not generate more wealth than the forest produces on its own, but nonetheless generates a positive net income. Thus, this investment could be justified, even though it does not create additional wealth relative to the situation without investment.

2.3.4.8 Analysis Tool

The tool used to produce the economic profitability analyses of the scenarios is the Modèle d'évaluation de la rentabilité des investissements silvicoles (MERIS - Silvicultural investment profitability assessment model)). It allows measuring of the economic benefits of production and processing of timber generated by the silvicultural scenarios. It is made available by the MRNF's Bureau de mise en marché des bois (BMMB - Timber Marketing Board) on its website. *https://bmmb.gouv.qc.ca/analyses-economiques/outils-d-analyse/*.

The version used for the preparation of the integrated forest development strategies presented in the 2023-2028 PAFITs and the Regional Timber Production Strategy is version 2.2.1.

As such, an analysis of the economic profitability of the various silvicultural scenarios is presented in the PAFIT document.

2.3.4.9 New Knowledge

The needs for knowledge are closely linked to the problems or issues of timber production, social issues and ecological issues. The Direction régionale de gestion des forêts du Nord-du-Québec focuses to developing and integrating new knowledge continuously into its practices.

2.3.5 MANAGEMENT MEASURES

The management measures specify the preferred means to ensure the issues are mastered and the objectives are achieved. They are deployed along three solution axes:

- inclusion, roads and infrastructure;
- spatial and temporal distribution of interventions
- adapted silvicultural treatments

The way in which these solutions will materialize for each Management Unit is presented in the PAFIT, considering the synergies with other forest management objectives, the silvicultural potential and the local operational capacity.

2.3.5.1 Inclusion, Roads and Infrastructure

Inaccessible portions of the territory may contribute to timber production through investments in roads and infrastructure.

2.3.5.2 Spatial and Temporal Distribution

Spatial distribution on the SOC scale

The spatial distribution approach on the SOC scale seeks to reproduce the footprint of the natural disturbances to which biodiversity is adapted. It also has the effect of concentrating the interventions, which favours control of supply costs.

Revolution or Rotation Period

The timing of the harvest affects timber losses by mortality, the quantity and quality of the volumes and the profitability of operations.

2.3.5.3 Adapted Silvicultural Treatments

The selection, frequency and intensity of silvicultural treatment can be adapted to influence the species to be produced, their quantities and their desired properties (qualities)

3. Regional and Local Issues

3.1 SPRUCE BUDWORM

3.1.1 SPRUCE BUDWORM MANAGEMENT FRAMEWORK

To reduce the negative consequences linked to the epidemic which has been raging for several years, the Ministère des Ressouces naturelles et des Forêts is implementing a proactive approach and deploying various means, in particular aerial spraying, reorientation of the harvest toward vulnerable or defoliated stands (preventive harvesting) and the adjustment of commercial and non-commercial silvicultural work (planning modulation). Annual and cumulative monitoring of defoliation damage caused by SBW, in particular through the intensification of aerial overflights and larval inventories, also makes it possible to closely monitor the progress of the infestation.

The targeted review of the forest regime, announced in November 2020, determines various measures, including adopting a proactive approach in the deployment of special management plans aimed at accelerating preventive harvesting and limiting wood loss.

In order to respond to this, the MRNF has developed a management framework for the Spruce Budworm which defines the harvesting orientations beyond the allowable cut in the Epidemic – Without mortality, Epidemic – With mortality and Endemic – Post-epidemic. The volumes thus determined must then be transposed into the special development plans. These volumes will ultimately be put up for sale through the timber auction process of the Bureau de mise en marché des bois (Timber Marketing Board) and by that of timber sales concluded by mutual agreement.

To learn more, consult:
PAFIT

3.1.2 BACKGROUND

As presented in the document *The Territory and its Occupants,* the Spruce Budworm is an insect pest that has a major impact on the vitality and growth of stands made up of Balsam Fir, White Spruce and Black Spruce. This is a major issue that must be considered in the Integrated Forest Development Strategy, particularly by the deployment of adapted silvicultural treatments.

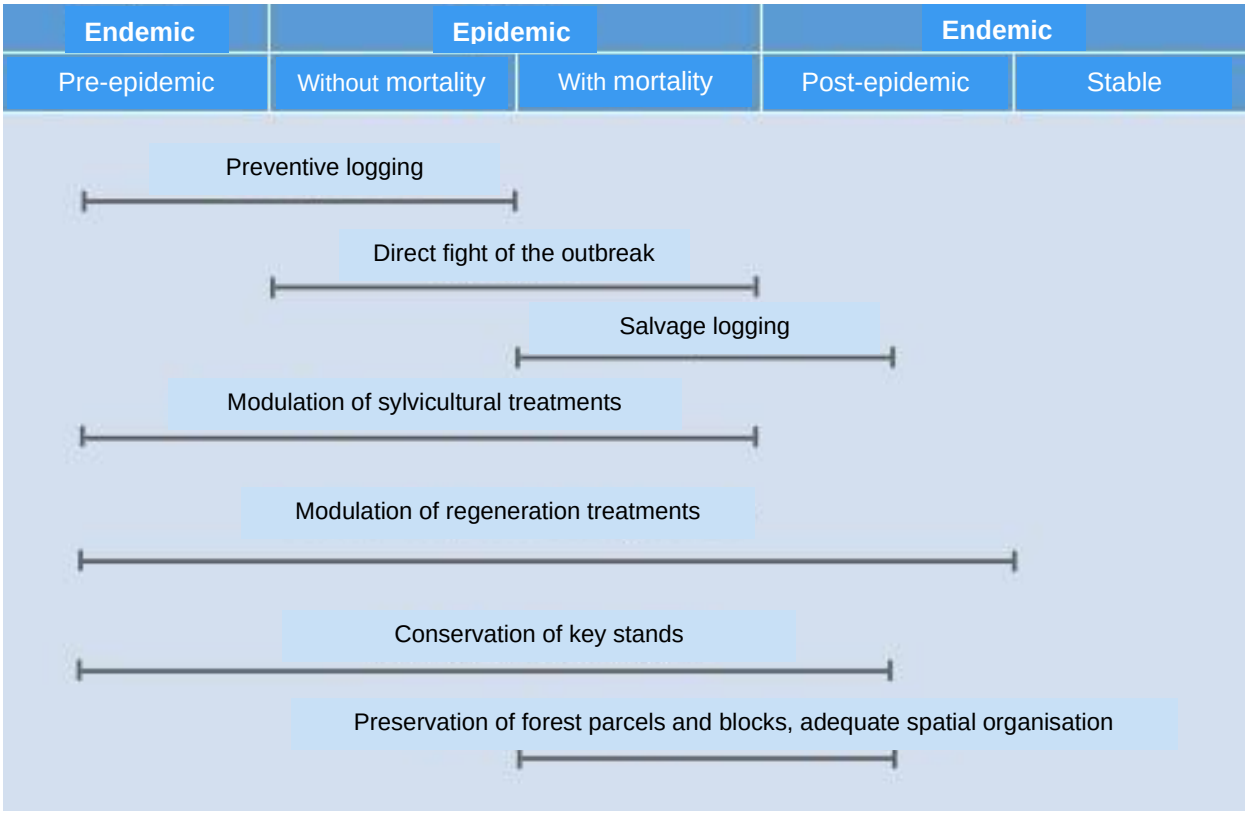
Although the MRNF assesses and considers the impact of SBW on the allowable cuts and the forest development strategy, it remains difficult to model the Spruce Budworm's evolution on the operational scale. This is why, in addition to the analysis produced during the preparation of the Tactical Integrated Forest Management Plans (PAFIT), the MRNF annually assesses the progression of SBW and adjusts the planning according to the vulnerability of the stands. This problem may lead to variances between the forest management strategy provided in the PAFIT and in the Operational Integrated Forest Management Plans (PAFIO). In the case the SBW epidemic is severe enough to necessitate the deployment of a special salvage plan, it is even possible that the strategy and the allowable cuts will not

be respected. Indeed, as provided in section 60 of the Sustainable Forest Development Act, the objective of the plan is to minimize losses of severely affected and degraded timber volumes.

Because SBW epidemics are cyclical, the forest manager must adapt the PAFITs and the PAFIOs according to the stage of the epidemic and the degree of mortality. In endemic periods, the forest manager will opt more for preventive harvesting of the most vulnerable stands to reduce susceptibility and vulnerability and increase the vigour of the residual stands.

In epidemic periods, it is essential to reduce the vulnerability of the susceptible stands and minimize the mortality-related timber losses. To do this, the forest manager will proceed with priority harvesting of the most vulnerable stands for which mortality is probable. It is also possible to proceed with modulation of the silvicultural treatments and forest management levels, and to reduce mortality by fighting it directly through aerial spraying with a biological insecticide, Btk. The objective of spraying is not to stop the epidemic, but to maintain the standing timber in the stands that will make it possible to supply the industry at the end of the epidemic. The table below presents the main means available according to the endemic and epidemic periods.

Table 35: Summary of the Means Available to Deal with the Epidemic



Source: MFFP (2014)

3.1.3 ANALYSIS OF THE ISSUE

To guide the analysis of the susceptibility and vulnerability of the stands and provide decision help tools to the forest manager and foresters, a reference guide has been produced by the MRNF. The *Guide de*

référence pour moduler les activités d'aménagement dans les forêts publiques (Reference guide to modulate forest management activities in public forests) is the keystone in SBW management.

To learn more, consult:

L'aménagement écosystémique dans un contexte d'épidémie de la tordeuse des bourgeons de l'épinette – Guide de référence pour moduler les activités d'aménagement dans les forêts publiques.

3.1.3.1 Analysis Scale

3.1.4 CURRENT STATE

The SBW pandemic phase in Québec began in 1992. However, the presence of the insect has been recognized in the territory of the Nord-du-Québec region only since 2020.

The assessment of the damaged areas in the region after the second epidemic year is 293,000 hectares of light damage, 40,000 hectares of moderate damage and 1,100 hectares of severe damage. The point of entry of the epidemic is centralized south of MU 87-51 of the MRNF local office (UG) of Quévillon, up to the northern limit of the municipality of Matagami.

The volumes available for harvesting of Balsam Fir (SAB) and White Spruce (EPB), which are vulnerable to SBW, were estimated at:

MRNF local office (UG) 102: 7.3%;

MRNF local office (UG) 105: 6.5%;

MRNF local office (UG) 106: 3.8%;

MRNF local office (UG) 107: 10.8%.

The stands dominated by vulnerable species are relatively rare and dispersed over the territory, rendering the forest cover on the landscape scale less vulnerable to an epidemic.

The epidemic's advance is monitored closely. The cumulative defoliation scores are not yet high enough in the region to consider production of a special salvage plan.

3.1.5 OBJECTIVES

- Monitor the epidemic's advance.
- Act preventively to reduce the vulnerability of the stands to SBW.

3.1.6 MANAGEMENT MEASURES

In the MUs affected by the epidemic, make sure, as much as possible harvest the zones (SOC scale) or the stands with the highest proportion of vulnerable species – Balsam Fir and White Spruce (SAB+EPB) as a priority. During preparation of the annual programs, the proportion of vulnerable species planned will be tracked. The target threshold corresponds to the proportion SAB + EPB/total volume available for harvesting in the territory.

3.1.6.1 Spatial and Temporal Distribution

To orient operational planning, we delimited spatial organization compartments (SOC) vulnerable to SBW throughout the region. In the MUs affected by the epidemic, the most vulnerable SOC are prioritized for harvesting, whenever possible.

On the stand scale, fine planning (delimitation of harvest blocks and residual forest blocks) also prioritizes the most vulnerable stands for harvesting, whenever possible.

3.1.6.2 Adapted Silvicultural Treatments

Exclude Balsam Fir (SAB) as a species to prioritize during tending work. Balsam Fir (SAB) plantations are to be proscribed and, during reforestation, Balsam Fir (SAB) is not considered to be a complementary stem.

Avoid partial cutting in the most vulnerable SOC; in the pandemic phase, the residual cover could be greatly reduced and compromise the silvicultural treatment objectives.

3.2 LOCAL ISSUES FROM NON-SIGNATORY INDIGENOUS COMMUNITIES

3.2.1 APPROACH TO ANALYZING LOCAL ISSUES

3.2.1.1 Identification of concerns

Indigenous communities have been working for several years to identify and document their various concerns as issues. Concerns from Indigenous communities touch on different themes, such as preserving biodiversity, wildlife habitats, landscapes, water quality and aquatic environments, as well as the implementation of good forestry practices or the accessibility to the territory. The key steps in developing solutions to the issues are:

- list and prioritize the concerns raised, and classify them by theme and priority order;
- collect data on prioritized concerns to determine if they raise real issues;
- seek solutions for these issues and forward recommendations, including supporting documentation, to regional management.
- Tables summarizing the concerns of Indigenous communities are presented at the beginning of their respective sections.

3.2.1.2 Data collection on issues and recommendation to the MRNF

Some concerns have been prioritized and are currently being the subject of discussions and data collection to identify issues and, potentially, solutions to address them. These “issues-solutions” are developed in a participatory approach and in consultation with experts and stakeholders involved in the territory. This approach not only allows for discussion and recognition of complex issues by all participants, which is crucial, but also greatly facilitates local cooperation.

3.2.1.3 Identification of solutions to issues

When the issues are sufficiently substantiated and solutions are proposed, they are submitted to the MRNF. These issues-solutions are then analyzed by regional management and may take different directions depending on their content.

For a variety of reasons, some issues cannot be incorporated into the PAFITs. For example, some issues are not the responsibility of regional management, run counter to departmental directions or arise from unfounded concerns (e.g., misperceptions). In addition, issues may require more analysis and reflection. Work with Indigenous communities continues to keep collecting data on the concerns expressed by the panel members.

Some elements are already taken into account through the laws and regulations governing forest activities. Examples include the LADTF, RADF and LEMV. Regulatory follow-up tools will monitor these elements.

Furthermore, issues-solutions can be integrated in different ways in forest management. For example, solutions may be the addition of specific meetings, specific follow-ups, best practices guides or operational harmonization measures, or they may be the integration of indicators and targets.

3.2.1.4 Concerns

Table 36: Summary of major themes of concern addressed by non-signatory Indigenous communities in the region

Endemic

Theme	Subtheme
Forestry	Non-timber forest products (PFNL)
	Ecosystem-based approach
	Harvesting frequency
	Reforested species type and reforestation quality
Environment quality	Habitat fragmentation
	Maintaining wildlife potential
	Biodiversity
	Conservation
	Groundwater water quality
	Protection of wetlands and aquatic ecosystems
Multi-purpose roads	Cohabitation with non-Indigenous persons
	Loss of wooded areas
Recreational tourism and cultural heritage	Lack of quality bark
	Maintaining aesthetic landscapes
	Sensitive sites
	Peace
Communication, consultation	Consultation process
	Aboriginal Participation Program (PPA)

For more information on specific Indigenous community concerns, please visit:

Concerns of the Ashishnabe First Nation of Lac-Simon
Concerns of the Abitibiwinni First Nation

4. Professional and Administrative Signatures

Ressources naturelles et Forêts
Québec

Professional and Administrative Signature Form

Tactical Integrated Forest Management Plan

Management Unit 02661, 02662, 02663, 02664, 02665, 02666, 08551, 08562, 08652, 08663, 08664, 08665, 08666, 08751, 08762, 08763 et 08764

This working version is made available for discussion during the participatory phase. It has been produced from all relevant information available to date and in compliance with the laws and regulations in force.

Professional responsibility

This Tactical Integrated Forest Management Plan (PAFIT) was produced under my professional responsibility based on all the relevant information available to date and in compliance with the legislation and regulations in force. I recommend it is approved by the Minister's representative

_____ Date _____

Paul-Maxime Otye-Moto, ing.f.no de permis 14-015
Coordonnateur des plans d'aménagement forestier intégré tactiques

I also certify that the following forest engineers contributed to its preparation for the work cited below.

_____ Date _____

Sabrina Morissette, ing.f. no de permis 05-020
Coordonnatrice aux affaires autochtones

_____ Date _____

Sébastien Leduc, ing.f. no de permis 03-031
Coordonnateur régional de la planification forestière

_____ Date _____

Jean-François Caron, ing.f. no de permis 06-033
Aménagiste pour les UA 02660

_____ Date _____

Gabriel Rheault, ing.f. no de permis 12-011
Aménagiste pour les UA 02660

_____ Date _____

Zlatko Blazeski, ing.f. no de permis 15-06
Aménagiste pour les UA 08551 et 08562

_____ Date _____

Marie-Ève Larouche, ing.f. no de permis 11-033
Aménagiste pour pour la planification non commerciale
UA 08551 et 8562

_____ Date _____

Dave Levasseur, ing.f. no de permis 12-035
Aménagiste pour les UA 08660 et 08652

_____ Date _____

Frédéric Lemelin, ing.f. no de permis 21-066
Aménagiste pour les UA 08660 et 08652

_____ Date _____

David Gagnon, ing.f. no de permis 11-010
Aménagiste pour les UA 08760 et 08751

_____ Date _____

Charles-Éric Décloître, ing.f. no de permis 17-022
Aménagiste pour les UA 08760 et 08751

J'atteste également que les biologistes suivants ont contribué à son élaboration pour les travaux cités ci-dessous :

_____ Date _____

Sonia Légaré, biologiste PH.D.

5. Appendix

APPENDIX A - NON-EXHAUSTIVE CONCERNS OF THE ANISHNABE NATION OF LAC-SIMON AND WORK PROGRESS

THEME	Concern	Status
Area of increased timber production	The community is concerned about the identification of areas of increased timber production (AIPL).	Abandoned
Terrestrial fauna	The community is concerned about harvest rates at the moose habitat level.	Ongoing
Terrestrial fauna	CONNECTIVITY: The fragmentation of the territory prevents the movement of certain species and may hinder their survival. Logging can produce riparian strips that are too narrow to be used as a wildlife travel corridor.	Not started
Terrestrial fauna	The community is concerned about harvest rates at the marten habitat level.	Not started
Sensitive site/landscape	The community is concerned about the degradation of the landscape as a result of harvesting.	Not started
Disturbance	The community is concerned about the degradation of peace during forest interventions.	Not started
Aquatic ecosystem	The community is concerned about the rate of harvest along aquatic ecosystems.	Not started
Non-timber forest products	The community is concerned about the impact of forestry operations on non-timber forest products (PFNL).	Ongoing

Source : Anishnabe Nation of Lac-Simon

APPENDIX B - NON-EXHAUSTIVE CONCERNS OF THE ABITIBIWINNI FIRST NATION AND WORK PROGRESS

THEME	Concern	Status
Sensitive site/landscape	Forest operations disturb and degrade the integrity of nearby sensitive sites and sites of interest.	Not started (modified in January 2023)
Sensitive site/landscape	The quality of the landscape of sensitive sites and sites of interest is degraded by harvesting operations in the vicinity of them, which prevents members of the community from enjoying the natural aesthetic of the territory.	Not started (modified in January 2023)
Terrestrial fauna	Education treatments for stands (e.g., clearing) can change the initial composition of a stand and thus alter the habitat potential for the wildlife species that use it. This does not allow for the continuation of traditional hunting and trapping activities based on usual hunting and trapping effort.	Ongoing
Terrestrial fauna	Reforestation can change the initial composition of a stand and thus alter the habitat potential for the wildlife species that use it. This does not allow for the continuation of traditional hunting and trapping activities based on usual hunting and trapping effort.	Ongoing
Terrestrial fauna	Too much total cutting leaves too little residual forest for marten, resulting in reduced harvesting potential at the trapline scale.	Not started
Terrestrial fauna	Habitat fragmentation caused by forestry operations prevents some animal species from moving from one area to another throughout the trapline.	Not started (modified in January 2023)
Terrestrial fauna	The development of watercourse crossings during road construction may result in a massive influx of sediment and adversely affect the quality of spawning areas not all known to the MRNF.	Not started
Non-timber forest products	Forest operations, including new forest roads, affect the abundance and quality of non-timber forest products (mushrooms, berries, plants, etc.).	Not started (modified in January 2023)
Non-timber forest products	Paper birch harvesting prevents Indigenous communities from sourcing quality bark for traditional objects (scarcity of quality birch stands).	Not started (modified in January 2023)
Multi-purpose roads	The new access routes to the territory increase the use by new users, which could degrade sensitive sites and compromise the territory's ability to support important community activities such as hunting and fishing.	Not started (modified in January 2023)
Old-growth forests	The loss of old-growth forests has a significant impact on our "pantry" and the transmission of traditional knowledge. Old-growth forests are part of our culture and shape our identity.	Not started (modified in January 2023)
Aquatic ecosystem	Knowledge and maintenance of groundwater quality.	Not started (modified in January 2023)
Aquatic ecosystem	Knowledge and maintenance of surface water quality.	Not started (modified in January 2023)

THEME	Concern	Status
Consultation process	Significant and recurring delays in the implementation of the PPA by the MRNF do not adequately support the community on an ongoing basis and leave the community without a valid consultation process.	Not started
Comprehensive demand/Financial return	The economic return on investment in Abitibiwinni Aki, particularly in silviculture and the maintenance/construction of forest roads, must not take precedence over consultation, conservation, creation of protected areas, harmonization, accommodation, and of course our rights and claims.	Not started (modified in January 2023)
Areas of increased timber production (AIPL) and intensive management	Areas of increased timber production (AIPL) and intensive and elite silviculture have significant impacts on the biodiversity and naturality of Abitibiwinni Aki. The Abitibiwinni First Nation is opposed to the designation of AIPLs or other similar designations.	Not started (modified in January 2023)
Woodland caribou (Val-d'Or population)	Habitat degradation for woodland caribou threatens the survival of the Val-d'Or population.	Not started (modified in January 2023)
Woodland caribou	Forest management, including forest roads, directly and indirectly threatens (influence on the abundance and effectiveness of predators such as wolf) the survival of the woodland caribou population.	Not started (modified in January 2023)
Naturality	Abitibiwinni Aki's loss of naturality and its unequal distribution throughout traplines affects the activities, traditions, customs, values and way of life of the Abitibiwinnik.	Not started (modified in January 2023)
Cumulative impacts	The lack of consideration of the cumulative effects of all land transformations in forest planning threatens the integrity of Abitibiwinni Aki.	Not started (modified in January 2023)
Special recovery plans	The consultation and harmonization process in developing recovery plans does not adequately address the concerns and interests of the Abitibiwinni First Nation.	Not started (modified in January 2023)
Degree of alteration	The degree of alteration of Abitibiwinni Aki (and lack of relevant spatial scale analysis) affects, among other things, the abundance of species important to Abitibiwinni First Nation (e.g., caribou and moose), diminishes the quality of available resources (e.g., contamination, wildlife health), changes access to the land (which often becomes more accessible to all users) and decreases appreciation of experiences lived in the territory.	Not started (modified in January 2023)
Wood transportation	Wood transportation threatens the safety and quiet of the Abitibiwinnik during their activities in the vicinity of the roads where there is transportation.	Not started (modified in January 2023)
Base scientifique	The glaring lack of scientific references in the PAFITs does not allow the Abitibiwinni First Nation to understand on what basis and on what scientific basis the MNRF is developing its strategies/issues/objectives/indicators/targets and does not allow it to position itself well on their soundness.	Not started (modified in January 2023)

Source : Abitibiwinni First Nation

6. References

FENTON. N. ET BERGERON, Y. (2006). *Facilitative succession in a boreal bryophyte community driven by changes in available moisture and light*. Journal of Vegetation Science 17: p. 65-76.

MINISTÈRE DES FORÊTS, DE LA FAUNE ET DES PARCS (2014). *L'aménagement écosystémique dans un contexte d'épidémie de la tordeuse des bourgeons de l'épinette* — Guide de référence pour moduler les activités d'aménagement dans les forêts publiques, Québec, Les publications du Québec, 127 p.

MINISTÈRE DES FORÊTS, DE LA FAUNE ET DES PARCS (2018). *Guide d'analyse économique appliquée aux investissements sylvicoles*, Québec, Les publications du Québec, 70 p.

MINISTÈRE DES FORÊTS, DE LA FAUNE ET DES PARCS (2020). *Cartographie du 5e inventaire écoforestier du Québec méridional* — Méthodes et données associées [En ligne] [*https://https://www.donneesquebec.ca/recherche/fr/dataset/resultats-d-inventaire-et-carte-ecoforestiere*/].

MINISTÈRE DES RESSOURCES NATURELLES (2013). *Le guide sylvicole du Québec, tome 1, Les fondements biologiques de la sylviculture*, ouvrage collectif sous la supervision de B. Boulet et M. Huot, Les Publications du Québec, 1044 p.

MINISTÈRE DES RESSOURCES NATURELLES (2013). *Le guide sylvicole du Québec, tome 2. Les concepts et l'application de la sylviculture*, ouvrage collectif sous la supervision de C. Larouche, F. Guillemette, P. Raymond et J.-P. Saucier, Les Publications du Québec, 744 p.

RHEAULT, H. (2013). *Éricacées. Fascicule 4.10*. Dans Bureau du forestier en chef, Manuel de détermination des possibilités forestières 2013-2018. Gouvernement du Québec, Roberval, Québec, p. 201-206. https://forestierenchef.gouv.qc.ca/wp-content/uploads/2013/01/201-206_MDPF_Ericacees.pdf

SIMARD, M., LECOMTE, N., BERGERON, Y., BERNIER, P.-Y. ET PARÉ, D. (2007). *Forest productivity decline caused by successional paludification of boreal soils*. Ecological Applications, 17, p.1619-1637.

Ressources naturelles et Forêts
Québec